

# TCMC MRI

## TRI-CITY MEDICAL CENTER

4002 VISTA WAY  
OCEANSIDE , CALIFORNIA 92056

# SPECIFICATIONS

PREPARED BY: ERIK LINDBERG, RA

SFEIR ARCHITECTS PROJECT NUMBER: 01907.01  
OSHPD #: S200813-37-00

DATE: 3/11/20

DELTA 1 OSHPD COMMENTS 8/3/2020

DELTA 2 DESIGN CHANGES 8/10/2020

DELTA 3 OSHPD COMMENTS 10/2/2020

DELTA 4 OSHPD COMMENTS 11/24/2020

DELTA 5 DESIGN CHANGES 11/24/2020

DELTA 6 DESIGN CHANGES 4/20/21



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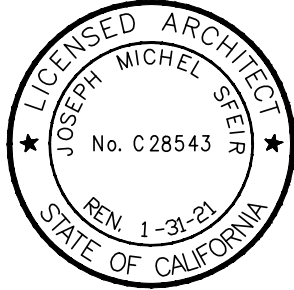
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**END OF SECTION**

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SEALS PAGE

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**SECTION 01 10 00  
SUMMARY**

**PART 1 GENERAL**

**1.01 GENERAL REQUIREMENTS**

- A Division 01 - General Requirements relates to and expands upon the Conditions of the Contract, including the General Conditions and the Supplementary Conditions, but does not supersede requirements specified in those documents or in the Owner/Contractor Agreement.
- B Division 01 - General Requirements governs work under all other divisions of the Specifications, including Project Specifications issued under separate cover, and the Drawings.
- C The general provisions of the Contract, including General Conditions and the Supplementary Conditions, Division 01 - General Requirements, and the Drawings apply to all Specifications, including Project Specifications issued under separate cover, whether or not explicit reference is made to these documents within any individual Project Specification section. The General Contractor is responsible to ensure that each subcontractor and supplier under the purview of the General Contractor is aware of these requirements and their applicability.

**1.02 PROJECT IDENTIFICATION AND PRINCIPAL ENTITIES**

- A Project Identification and Location:
  - TCMC MRI
  - 4002 Vista Way
  - Oceanside , California 92056
- B Owner: Wherever the word "Owner" is used in this Project Manual, it shall mean:
  - Owner's Name: Tri-City Medical Center.
  - 4002 Vista Way
  - Oceanside, California 92056
- C Architect: Wherever the word "Architect" is used in this Project Manual, it shall mean:
  - Architect's Name: SFEIR Architects.
  - 5151 Shoreham Place, Suite 100
  - San Diego, California 92122
- D General Contractor: Wherever the words "Contractor" or "General Contractor" are used in this Project Manual, they shall mean the contractor who is party to the Owner/Contractor Agreement.

**1.03 WORK COVERED BY CONTRACT DOCUMENTS**

- A Single Contract: Unless otherwise indicated or specified, all Work indicated on the Drawings and described in the Specifications is to be executed under one prime contract between Owner and General Contractor.
- B Scope of Work: See project drawings for scope of work.
- C The locations of all existing utilities, as indicated on the Drawings, are approximate. General Contractor shall be responsible for verifying location of all underground and above ground utilities indicated on the Architectural, Mechanical, and Electrical Drawings prior to construction. Any damage to these utilities shall be the Contractor's responsibility and they shall be repaired at no cost to the Owner.
- D Failure to Visit Site: Will not relieve Contractor from necessity of furnishing materials or performing work that may be required to complete the Work in accordance with Drawings and Specifications without additional cost to Owner.

**1.04 WORK BY OWNER OR UNDER SEPARATE CONTRACT**

- A Work by Others to be Executed During or After Completion of this Contract:
  - 1. Remediation of Hazardous Materials: No information is available regarding possible hazardous materials in the structures designated for demolition or the areas designated for remodeling. If hazardous materials, such as asbestos or lead-based paints, are encountered, remediation of such materials will be performed by others under separate contract to the Owner. Immediately notify Owner if such materials are observed before or during demolition operations. Coordinate with Owner to reschedule demolition and construction work to be completed after remediation is accomplished.
  - 2. Other items indicated to be by Owner, OFOI, or not in contract (N.I.C.) on Drawings.

## 1.05 COORDINATION WITH OCCUPANTS

- A Owner intends to continue to occupy the premises during entire construction period with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits, unless otherwise indicated.
  - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
    - a. Emergency Exits: Maintain all required fire exits from existing building at all times existing building is occupied during construction process.
    - b. Exit Doors, Stairways and Discharge Areas: Acceptable to local code authority.
  - 2. Take precautions to allow for continued medical center operations including employee and public access.
  - 3. Related Requirements: See Section 01 35 16 Alteration Project Procedures.
- B Disruptive Operations: Noisy and disruptive operations (such use of jack hammers and other noisy equipment) shall not be allowed within existing building without prior authorization by the Owner.
  - 1. Schedule and coordinate such operations with Owner so that they occur at least disruptive times.
  - 2. Upon notification from Owner, cease operations which are, in opinion of Owner, disruptive to occupants.
- C Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Owner's written permission.
  - 3. In general outages shall be scheduled at times when the building is not being utilized by occupants.
- D Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- E Construction Parking: Parking for construction labor on site shall be coordinated with the Owner.
- F No smoking or use of tobacco products anywhere on Owner's property shall be allowed.

## 1.06 CONTRACTOR USE OF SITE

- A General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits and as defined at the Pre-construction Conference.
- B Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of building or Project site beyond areas in which the Work is indicated.
  - 1. Owner Occupancy: Restrict access to extent required to allow for on-going occupancy of portions of the building outside the area of work.
  - 2. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.
  - 1. Related Requirements:
    - a. Section 01 35 16 Alteration Project Procedures.

- D On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours, Monday through Friday, unless specifically authorized by the Owner's Representative.
  - 1. Provide access to and from site as required by law and by Owner:
    - a. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
    - b. Do not obstruct roadways, sidewalks, or other public ways without permit.

1.07 WORK SEQUENCE AND CONSTRUCTION PHASING

- A Sequencing of Construction Plan: Before start of construction on site, submit three copies of construction plan regarding access to work; use of site; and scheduling and phasing of new, demolition and renovation work for acceptance by Owner and Architect. After acceptance of plan, construction sequencing shall comply with accepted plan unless deviations are accepted in writing.
  - 1. No work may commence until Notice to Proceed is provided by the Owner.

1.08 PROJECT MANUAL FORMATS AND CONVENTIONS

- A MasterFormat: This Project Manual is organized on the basis of the 2016 Edition of the Construction Specifications Institute (CSI) MasterFormat.
  - 1. The system of groups, subgroups and Divisions are listed in the Table of Contents of this Project Manual. It consists of 50 Divisions, Division 00 though Division 49, some of which are not used or are reserved for future expansion of the MasterFormat.
- B Specification Language: These Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences.
  - 1. Omissions of words or phrases such as "the contractor shall", "in conformity therewith", "shall be", "as noted on the Drawings", "a", "the", are intentional.
  - 2. Supply omitted words or phrases by inference.
  - 3. Supply words "shall be" or "shall" by inference when colon is used within sentences or phrases.
  - 4. Supply words "on the Drawings" by inference when "as indicated" is used with sentences or phrases.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

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**SECTION 01 25 00  
SUBSTITUTION PROCEDURES**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A Section Includes:
  - 1. Administrative and procedural requirements for consideration of requests for substitution during the construction phase of the Project.
  - 2. Product substitution procedures.
  - 3. Execution substitution procedures.
- B Related Requirements:
  - 1. General Conditions.
  - 2. Product Requirements: Section 01 60 00.

**1.02 LIMITATIONS ON SUBSTITUTIONS**

- A During Procurement Phase: Comply with Instructions to Bidders.
- B During Construction Phase: Requests for substitutions of products will be considered only within 35 days after date of Owner-Contractor Agreement. Other requests will be considered only in case of product unavailability or other conditions beyond control of Contractor.
- C Substitutions:
  - 1. Will not be considered when indicated on shop drawings or product data submittals without separate formal request, when requested directly by subcontractor or supplier, or when acceptance will require substantial revision of Contract Documents.
  - 2. Do not order or install substitute products without written acceptance.
  - 3. Only one request for substitution for each product will be considered. When substitution is not accepted provide specified product.
  - 4. Architect will determine acceptability of substitutions.
  - 5. In addition to other requirements, proposed substitutions also require specific prior approval by OSHPD.
- D Value Engineering: For "value engineering" or similar cost or time reduction proposals that would result in changes to the Drawings and Specifications, the Contractor shall follow procedures specified herein and any and all such changes are to be submitted in "Substitution Approval Request Form" provided by Architect upon request of the Contractor.

**1.03 CONTRACTOR REPRESENTATION**

- A Request for Product Substitution: Representation that Contractor has investigated proposed product and has determined that it is equal to or superior in all respects to specified product:
  - 1. Contractor will provide same warranty for substitution as for specified product.
  - 2. Contractor will coordinate installation of accepted substitute, making such changes as may be required for work to be complete in all respects.
  - 3. Contractor waives claims for additional costs related to substitution which may later become apparent.
- B Replacement: If substituted products do not meet or exceed above requirements, whether before, during, or after incorporated into work, Contractor shall, at no additional cost to Owner, replace substituted products with products originally specified.

**1.04 SUBSTITUTION REQUEST SUBMITTAL PROCEDURES**

- A Submittal : Submit two copies of each request. Submit separate request for each substitution.
  - 1. Identify products by Specifications section and article numbers.
  - 2. Provide manufacturer's name and address, trade name of products, and model or catalog number.
  - 3. List fabricators and suppliers as appropriate.
- B Documentation: Document each request with complete data substantiating compliance of proposed substitution with requirements of Contract Documents:

1. Attach Product Data as specified in Section 01 33 00.
  2. Give itemized comparison of proposed substitution with specified product, listing variation, and reference to specification section and article numbers.
  3. Give quality and performance comparison between proposed substitution and specified product.
  4. List availability of maintenance services and replacement materials.
  5. State effect of substitution on construction schedule, and changes required in other work or products.
  6. Reference UL Fire Resistance Directory design number if applicable.
- C Architect: Will review Contractor's requests for substitutions with reasonable promptness.
1. If accepted by Architect, products proposed for substitution will be accepted subject to modifications by manufacturer, if necessary, to meet detailed requirements of Drawings and Specifications.
  2. Architect will not make exhaustive attempt to determine that products proposed for substitution are equal to, or can be modified in order to be equal to specified products.
- D Architect's Acceptance: Architect will notify Contractor, in writing, of decision to accept or reject requested substitution.
- E For Accepted Products: Submit shop drawings, product data, and samples in accordance with Section 01 33 00.

**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 SUMMARY**

- A This section specifies administrative and procedural requirements necessary for handling and processing Contract modifications.
- B Related Sections: The following sections contain requirements that relate to this section:
  - 1. Section 01 33 00 Submittal Requirements for requirements for the Contractor's Construction Schedule.
  - 2. Section 01 29 00 Payment Procedures for administrative procedures governing application for payment.

**1.02 MINOR CHANGES IN THE WORK**

- A Supplemental Instructions authorizing minor change in the Work, not involving an adjustment to the Contract Sum or Contract Time, may be issued by the Architect on an AIA form G711, Architect Supplemental Instructions.

**1.03 CHANGE ORDER PROPOSAL REQUESTS**

- A Owner-Initiated Proposal Request: Proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time will be issued by the Owner, with a detailed description of the proposed change and supplemental or revised Drawings and Specifications, if necessary.
  - 1. Proposal requests issued by the Owner are for information only. Do not consider them instruction either to stop work in progress, or to execute the proposed change.
  - 2. Unless otherwise indicated in the proposal request, within 30 days of receipt of the proposal request, submit to the Architect and the Owner 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. Where requested, furnish survey data to substantial 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 unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the Owner and Architect.
  - 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 the quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, 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 - Substitution Procedures if the proposed change in the work requires the substitutions of one product or system for a product or system specified.
- C Proposal Request Form: Use forms approved by the Owner for Change Order Proposals.

**1.04 CHANGE ORDER PROCEDURES:**

- A In addition to the procedure and information stated in the section, herein before: the Contractor shall follow Change Order procedures and information as stated in the General Conditions of the Contract and on the Bid Form.

- B Upon the Owner's approval of a Change Order proposal Request, the owner will issue a Change Order for signatures of the Owner, Contractor, and Architect.
- C OSHPD Approvals: In accordance with Part 1, Title 24, California Code of Regulations, all addenda and modifications to the Work requiring OSHPD approval shall be approved by the Office of Statewide Health Planning and Development (OSHPD) prior to proceeding with the work.

1.05 CONTRACT MODIFICATION LOG

- A All changes to the Contract Documents, including change orders and minor non-material modifications, shall be logged for the Project record by the Architect.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 29 00  
PAYMENT PROCEDURES**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A This Section specifies administrative, and procedural requirements governing the Contractor's Applications for Payment.
- B The Contractor's Construction Schedule and Submittal Schedule are included in Section 01 33 00 - Submittal Procedures.

**1.02 COORDINATION**

- A Coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.
  - 1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:
    - a. Contractor's construction schedule.
    - b. Application for Payment form.
    - c. List of subcontractors.
    - d. Schedule of allowances.
    - e. List of products.
    - f. List of principal suppliers and fabricators.
    - g. Schedule of submittals.
  - 2. Submit the Schedule of Values- Schedule Amounts to the Owner at the earliest feasible date, but in no case later than 7 days before the date schedule for submittal of the initial Application for payment.

**1.03 SCHEDULE OF VALUES**

- A Identification; Include the following Project identification on the Schedule of Values:
  - 1. Name of Owner.
  - 2. Project name and location.
  - 3. Name of Architect.
  - 4. Project number.
  - 5. Contractor's name and address.
  - 6. Date of submittal.
- B Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed;
  - 1. Generic name.
  - 2. Related Specification Section.
  - 3. Name of subcontractor.
  - 4. Name of manufacturer or fabricator.
  - 5. Name of supplier.
  - 6. Change Orders (numbers) that have affected value.
  - 7. Dollar value.
  - 8. Percentage of Contract Sum to the nearest one-hundredth percent, adjusted to total 100 percent.
- C Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress evaluation of Applications for Payment and progress report. Break principle subcontract amounts down into several line items.
- D Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.
- E 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 and Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be completed including its total cost and proportionate share of general overhead and profit margin.
  - G 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.
  - H Schedule Updating: Update and resubmit the Schedule of Values when change Orders result in a change in the Contract sum.
- 1.04 APPLICATIONS FOR PAYMENT:
- A Each Application for payment shall be consistent with previous applications and payments and 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 involved additional requirements.
  - B Payment Application Times: The date for each progress payment is the first construction progress meeting of each month. The period of construction Work covered by each Application for Payment is the period ending at the last day of the month prior to the date for each progress payment and starting the day following the end of the preceding period.
  - C Payment Applications Forms: Use AIA Document G702 and G703.
  - 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 schedule 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 5 executed copies of each Application for payment to the Owner and Architect at the first of the bi-weekly Construction Progress Meeting. This meeting will extend into preview and acceptance by all required parties of the Contractors application of payment.
    - 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 Mechanic liens from subcontractors or sub-subcontractors and supplier for the construction period covered by the pervious application.
    - 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.
  - G The Owner reserves the right to designate which entities involved in the Work must submit waivers.
    - 1. Wavier Delays: Submit each Application for Payment with the Contractors Wavier of Mechanics lien for the period of construction covered by the application.
    - 2. Submit final Application for payment with or proceeded by final wavier from every entity involved with performance with Work covered by the Application who could lawfully be entitled to a lien.
    - 3. Waiver Forms: Submit Wavier of lien of forms, and executed in a manner, acceptable to Owner.
  - H Initial Application for payment: Administrative action and submittal that must precede or coincide with submittal of the first Application for Payment includes but not limited to the following:
    - 1. List of subcontractors and their agreements with the Contractor.

2. List of principal suppliers and fabricators.
  3. Schedule of Values.
  4. Contractors Construction Schedule (preliminary if not final).
  5. Schedule of principal products.
  6. Submittal Schedule (preliminary if not final).
  7. List of Contractor's staff assignments.
  8. List of Contractor's principal consultants.
  9. Copies of building permits.
  10. Copies of authorization and licenses from governing authorities for performance of the Work.
  11. Certificates of insurance and insurance policies.
  12. Data needed to acquire Owner's insurance.
- I Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, on the entire project, submit an Application for Payment.
- J Administrative actions and submittals that shall precede or coincide with this application include:
1. Occupancy permits and similar approvals.
  2. Warranties (guarantees) and maintenance agreements.
  3. Test / adjust / balance records.
  4. Maintenance instructions.
  5. Changeover information related to owner's occupancy, use, operation and maintenance.
  6. Final cleaning.
  7. Application for reduction of retainage, and consent of surety.
  8. Advice on shifting insurance coverage.
  9. Final progress photographs.
  10. List of delayed work, recognized as exceptions to Architect's Certificate of Substantial Completion.
- K Final Payment Application: Administrative actions and submittals, which must 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. Assurances that work not complete and accepted will complete without undo delay.
  5. Transmittal of required Project Construction Records to the Owner.
  6. Proof that taxes, fees and similar obligations have been paid.
  7. Removal of temporary facilities and services.
  8. Removal of surplus materials, rubbish and similar elements.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

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**SECTION 01 31 13  
PROJECT COORDINATION**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A This section specified administrative and supervisory requirements necessary for Project coordination including, but necessary limited to:
  - 1. Coordination.
  - 2. Administrative and Supervisory personnel.
  - 3. General installation provision.
  - 4. Cleaning and protection.
  - 5. Time and Manner.
- B Progress meetings, coordination meetings and pre-installation conferences are included in:
  - 1. Section 01 31 19 - Project Meetings.
  - 2. Requirements for the Contractor's Construction Schedule are included in Section 01 33 00 - Submittal Procedures.

**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 include 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 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.

**1.03 ADMINISTRATIVE AND SUPERVISORY PERSONNEL**

- A Make adequate provisions to accommodate items scheduled for later installation.
- B Administrative Procedures: Coordinate scheduling and timing of required Administrative Procedures with other constructions 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 closeout activities.
- C Conservation: Coordinate Construction activities to ensure that operations are carried out with considerations given to conservation of energy, water, and materials.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work. Refer to other sections for disposition of salvaged materials that are designated as Owner's property.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 GENERAL INSTALLATION PROVISIONS**

- A 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.
- B 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.

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

3.02 GENERAL INSTALLATION PROVISIONS:

- A Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.
- B 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.
- C Recheck measurements and dimensions, before starting each installation.
- D Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- E Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized with the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for the final decision.

3.03 CLEANING AND PROTECTION

- A Cleaning and Maintenance:
  - 1. Special cleaning requirements for specific units of Work are included in the appropriate sections of the specifications. Final cleaning is required under Section 01 77 00 - Closeout Procedures.
  - 2. The Contractor shall remove and dispose of all waste materials and rubbish due to all construction operations under the contract.
- B Protection: In addition to the General Conditions, the Contractor or alteration work. Use only new materials in construction of all protection. If wood is called for, it shall be fire retardant treated wood if used within the interior of the building. No cutting of materials shall be done within occupied spaces.

3.04 OWNER OCCUPANCY:

- A Partial Owner Occupancy: The Owner reserves the right to place and install equipment as necessary in completed areas of the building and to occupy such completed areas prior to substantial completion, provided that such occupancy does not substantially interfere with completion of the work. Such placing of equipment and partial occupancy shall not constitute acceptance of the work or any part of the work.

**END OF SECTION**



## SECTION 01 31 19

### PROJECT MEETINGS

#### PART 1 GENERAL

##### 1.01 PRECONSTRUCTION CONFERENCES

- B. Site Mobilization Conference: Meeting will be scheduled by Design/Builder at site immediately prior to Contractor move-in. Representatives of Contractor, Mechanical and Electrical Subcontractors, Geotechnical Engineer, Architect and Design/Builder's Consultants will be present. Job site procedures to include following items will be discussed:
1. Procedures for maintaining project record documents.
  2. Owner's requirements.
  3. Construction facilities and controls.
  4. Temporary utilities.
  5. Security and housekeeping procedures.
  6. Materials testing.
  7. Requirements of start-up trades.
  8. Building layout.
  9. Communications with Design/Builder's consultants.

##### 1.02 PROGRESS MEETINGS

- A. Scheduling, Attendance and Agenda: Design/Builder will schedule regular periodic meetings at Design/Builder's job site field office. Representatives of Owner and Architect will be invited to attend. Also invited as appropriate to items under discussion, shall be selected subcontractors and suppliers and Architect's consultants. Review present and future needs of each entity present, including the following:
1. Review of work progress since previous meetings.
  2. Field observations, problems, conflicts.
  3. Problems that impede construction schedule.
  4. Review of off-site fabrication, delivery schedules.
  5. Corrective measures and procedures to regain projected schedule.
  6. Revisions to construction schedule.
  7. Plan progress, schedule during succeeding work period.
  8. Coordination of schedules.
  9. Maintenance of quality standards.
  10. Review submittal schedules; expedite as required.
  11. Review proposed changes for effect on other trades, construction schedule and completion date.
  12. Coordination of separate contracts.
  13. Other business as required.
- B. Agenda and Minutes: Design/Builder will establish agenda and keep and distribute minutes of progress meetings and lists of those present and others as directed.
- C. Persons Representing Contractor at Meetings: Have authority to commit Contractor to solutions agreed upon in meetings. To maximum extent possible, assign same person or persons to represent Contractor at meetings throughout progress of Work.
- D. Coordination Meetings: Progress meetings shall in no way be considered substitute for Contractor/subcontractor coordination meetings.

### 1.03 PRE-INSTALLATION CONFERENCES

- A. The Design-Builder will conduct a preinstallation conference at the Project Site before each construction activity that requires coordination with other construction.
- B. Attendees: 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 and times.
- C. Review the progress of other construction activities and preparations for the particular activity under consideration at each preinstallation conference, including requirements for the following:
  - 1. Contract Documents.
  - 2. Options.
  - 3. Related Change Orders.
  - 4. Purchases.
  - 5. Deliveries.
  - 6. Shop Drawings, Product Data, and quality-control samples.
  - 7. Review of mockups.
  - 8. Possible conflicts.
  - 9. Compatibility problems.
  - 10. Time schedules.
  - 11. Weather limitations.
  - 12. Manufacturer's recommendations.
  - 13. Warranty requirements.
  - 14. Compatibility of materials.
  - 15. Acceptability of substrates.
  - 16. Temporary facilities.
  - 17. Space and access limitations.
  - 18. Governing regulations.
  - 19. Safety.
  - 20. Inspecting and testing requirements.
  - 21. Required performance results.
  - 22. Recording requirements.
  - 23. Protection.
- D. Record significant discussions and agreements and disagreements of each conference, and the approved schedule. The Design-Builder will distribute the record of the meeting to everyone concerned, including the Owner and the Architect.
- E. Do not proceed with the installation 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.

**PART 2 PRODUCTS** – Not Used

**PART 3 EXECUTION** – Not Used

END OF SECTION

## SECTION 01 33 00

### SUBMITTAL PROCEDURES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Action Submittals.
- B. Informational Submittals.

##### 1.02 RELATED REQUIREMENTS

- A. Products List: Section 01 60 00 Product Requirements.
- B. Final Paperwork, Project Record Documents, Operation and Maintenance Data, and Warranties: Section 01 78 00 Closeout Submittals.

##### 1.03 SCHEDULING

- A. Submittals: Made early enough to account for processing described below and reasonable period for review by Architect and Engineers. Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
  - 1. Allow at least 10 days for initial review for Submittal submitted per Submittal Schedule. Allow additional time if processing must be delayed to permit coordination with subsequent submittals or if submittal is unscheduled. Design/Builder will promptly advise the Subcontractor when a submittal being processed must be delayed for coordination.
  - 2. If an intermediate submittal is necessary, process the same as the initial submittal.
  - 3. Allow at least 10 days for reprocessing each submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

##### 1.04 SUBMITTALS SCHEDULE AND CODING PROCEDURES

- A. Submittal: Before any items are submitted for review, prepare and submit to Architect two copies of complete schedule of all submittals anticipated to be made during progress of Work.
- B. The schedule of submittals shall address the entire Project, and shall contain the following:
  - 1. Shop Drawing Schedule.
  - 2. Sample Schedule.
  - 3. Product data.
  - 4. Certificates of Compliance.

5. Warranties.
  6. Other types of submittals as required in Divisions 02 through 49.
- C. The schedule of submittals shall list all of the submittals required of each trade; the item, description, type, quantity and size (where applicable) of each submittal; and the following dates, as estimated:
1. Required date of submittal.
  2. Required date of approval.
- D. Number Coding: On schedule, designate each item with number code utilizing specification section six or eight digit numbers for the initial coding. Multiple items specified in a single specification section may be coded separately by utilizing Level 3 and/or Level 4 designations and numbers in accordance with the 2020 CSI MasterFormat. Alphanumeric Level 5 extensions are optional.
1. Each Submittal: Marked with same code designation.
- E. Coordination: Coordinate schedule with subcontractors and materials suppliers.
- F. Each schedule shall allow adequate time for review by the Architect and Engineers. The Architect and Engineers will not be responsible for Work performed in shop or field prior to approval. Long lead items requiring expedited action shall be clearly indicated.
- G. On acceptance by Architect, Contractor shall adhere to schedule except when specifically otherwise permitted.
- H. Revisions: Revise and update schedule on monthly basis as necessary to reflect conditions and sequences. Promptly submit any revised schedules to Architect for review.

#### 1.05 TRANSMITTALS

- A. Package each submittal appropriately for coherent content following coding established by Submittals Schedule.
- B. Shop Drawings, Product Data, Certificates, Manufacturer's Instructions, and All Other Submittals, Except Samples, Unless Otherwise Directed By Architect: Convert drawings, data sheets, and other written and graphic information to Portable Document Format (PDF) for electronic transmittal. Unless otherwise directed, transmit to Architect as follows:
1. On USB flash drive, compact disk (CD), or other digital media acceptable to Architect, delivered to Architect's address listed in the Project Directory.
  2. As email attachments, sent to Architect at address listed in Project Directory.
  3. Uploaded to Project website, if applicable.
- C. Samples:
1. Package each submittal appropriately for transmittal and handling.
  2. Transmit each set of samples from Contractor to Architect or applicable Engineer at address listed in the Project Manual or as otherwise directed.
    - a. Samples specified as field samples or mock-ups shall be constructed at the Project site as specified.
- D. Include transmittal letter with each submittal using AIA Document G810 or other Architect accepted transmittal form. Identify item by above code designation and reference to specification section. Use separate transmittal for each submittal.
1. Each Submittal: Have chronological submittal number.
  2. Resubmittals: Have original submittal number and letter in alphabetical order for each resubmittal.

3. On the transmittal, identify Project Contractor, Subcontractor, major Supplier; record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification stamp on each submittal certifying that information complies with Contract Document requirements.

#### 1.06 ACTION SUBMITTALS, GENERAL

- A. Action Submittals: For submittals where action and return is required or requested: Contractor shall review each submittal, mark to indicate action taken, and return within time period specified herein.
  1. Compliance with specified characteristics is the Contractor's responsibility.
  2. Unless otherwise specified, Action Submittals include, but are not necessarily limited to, shop drawings, product data, calculations and samples.
  3. Submittals for Information, Closeout Documents, Record Documents and Other Submittals for Similar Purposes: No action will be taken.
  4. Mechanical and Electrical Submittals: Broken down into parts so that individual parts can be resubmitted without confusion.
  5. Deviations: Clearly mark and note any deviations from Contract Documents in submittals.
- B. Contractor: Before submitting to Architect, review submittals for accuracy, completeness, and conformity with Contract Documents. Stamp with Contractor's stamp/date as evidence of such checking and coordination. Signature of individual who reviewed shop drawings is required below Contractor's stamp.
  1. The Contractor's review of Shop Drawings, Product Data and Samples shall include, without limitation, verification of the following:
    - a. Proper title, original date, drawing number (which shall be changed if resubmitted), revision numbers and dates, designation of Project Contractor, subcontractor and/or supplier.
    - b. Identification of Shop Drawings, Product Data or Samples by Specification Section and subsection or paragraph where appropriate and identification of Contract Drawings by number and detail.
    - c. Shop drawings, product data and schedules shall be checked and coordinated with the work of other trades involved, if any.
- C. Architect and Engineers will review each scheduled submittal once. Items submitted without sufficient information, or found to be inadequately prepared will be rejected.

#### 1.07 PRODUCT DATA

- A. Product Data: Submit for review manufacturer's current product literature and technical data indicating products proposed for use in the Project in compliance with the requirements of the Drawings and Specifications. Mark each copy to identify applicable products, models, options, and other data; supplement manufacturer's standard data to provide information unique to the Work. Include manufacturer's installation instructions when required by the Specification section.
  1. Reference: Reference product data to applicable Drawings and Specification sections to facilitate ease and accuracy of checking.
  2. When contents of submitted literature from manufacturers includes data not pertinent to submittal, clearly indicate which portion of contents is being submitted for review.
- B. Product Data submittals shall bear:
  1. The date.
  2. The name of the Project.
  3. Consecutive numbering.
  4. The Contractor's stamp of approval.

C. Subcontractor: Submit brochure material and any required samples.

## 1.08 SHOP DRAWINGS

A. Shop Drawings: Submit for review. Make particular note of field-measured dimensions, as-built conditions, and conditions requiring special coordination with other contractors.

1. Field Measurements: Responsibility of Contractor.
2. References: Reference shop drawings to applicable Drawings and Specification sections to facilitate ease and accuracy of checking.

B. Drawings shall be complete, bound in sets, and shall bear:

1. The date.
2. The name of the Project.
3. Consecutive numbering.
4. The Contractor's stamp of approval.

C. Drawing Requirements:

1. Except for templates, patterns, and similar full sized Drawings, submit Shop Drawings on sheets at least 8 ½ inches by 11 inches, but no larger than 36 inches by 42 inches.
2. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard manufacturer's information prepared without specific reference to the Project is not considered Shop Drawings.
3. Highlight, encircle, or otherwise indicate deviations from the Contract Documents.
4. Provide space for Contractor and Architect review stamps.

D. Contractor's Review and Submission:

1. Review shop drawings for accuracy, completeness, and conformity with Contract Documents. Make notes and corrections.
2. Stamp with Contractor's stamp/date. Signature of individual who reviewed shop drawings is required below Contractor's stamp.
3. Shop drawings not stamped and signed by Contractor will be returned by Architect.

E. Architect's and Consultant's Review: Review drawings, making notes and corrections. Stamp "No Exceptions Taken", "Revise and Resubmit", "Rejected", etc. as appropriate.

F. Subcontractor's Revisions and Distribution:

1. Make corrections noted by reviewers.
2. Make necessary copies for use in fabrication, installation, for record, distribution, etc.
3. Provide one corrected set to Contractor for inclusion in Record Documents to be maintained at Project site.

G. Resubmittal: In event shop drawings have to be resubmitted, Subcontractor shall make corrections and transmit to Contractor for resubmittal as specified above.

H. Approval: The approval of drawings and schedules by the Architect/Engineer will be general, but approval shall not be construed: (1) as permitting any departure from the Contract requirements; (2) as relieving the Contractor of the responsibility for any errors, including details, dimensions, materials, etc.; (3) as approving departures from full size details furnished by the Architect, except as otherwise provided herein.

1. If shop drawings show variations from the Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variations in its letter of transmittal. If acceptable, the Architect may approve any or all such variations.
2. If the drawings or schedules as submitted indicate variations from the Contract requirements that the Architect finds to be in the interest of the Project, the Architect may approve the variations.

I No work shall be fabricated, save at the Contractor's risk, until such approval has been received.

#### 1.09 SAMPLES

- A. The Contractor shall furnish for the review by the Architect, all samples required by the Specifications or by the Architect. Samples shall be delivered to the Architect unless otherwise directed. The Contractor shall prepay all shipping charges on samples. Materials or equipment for which samples are required shall not be used in the work until approved in writing by the Architect, save only at the Contractor's risk and expense.
- B. Checklist: Architect will provide Contractor with checklist indicating materials where color, texture or finish is subject to selection by Architect. Certain other samples may also be requested for use by Architect in preparation of color and material sample presentations for Owner.
- C. Submittal: Promptly after receipt of checklist, assemble and deliver to Architect complete collection of required samples. Unless otherwise specified, submit samples in quantity that is required to be returned plus one that will be retained by Architect.
- D. Samples: Bear tag or label large enough for acceptance stamp and providing following information:
  - 1. Project name and location.
  - 2. Contractor, subcontractor, manufacturer, supplier.
  - 3. Name, finish, and composition of material.
  - 4. Name of producer and brand (if any).
  - 5. Place of origin.
  - 6. Location of where material is to be used.
  - 7. Specification section number and a unique number reference.
  - 8. Date of submission.
  - 9. Provide samples of finished materials with additional markings to identify them under the finish schedules.
- E. At time of each shipment of samples the Contractor shall mail under separate cover a letter containing the information required above. Enclose a copy of this letter with the shipment.
- F. Selection: Upon receipt of complete collection of samples, Architect will, with reasonable promptness, make selections and prepare and deliver to Contractor schedule covering items subject to selection. Architect reserves right not to make individual determination or selections until all samples of all materials are submitted.
- G. Approval of a sample shall be only for the characteristics or use named. Such approval shall not be construed to change or modify any Contract requirement. Before submitting the samples, the Contractor shall verify that the materials or equipment will be available in the quantities required for the Project; because no change or substitution will be permitted after a sample has been approved.
- H. Failure of any material to pass the specified tests will be sufficient cause for refusal to consider any further samples of the same brand or make of that material. The Architect and Design/Builder reserve the right to disapprove any materials or equipment which previously have proved unsatisfactory in service.
- I. Samples of various materials or equipment delivered on the site or in place may be taken by the Architect's Representative for testing. Samples failing to meet Contract requirements will automatically void previous approvals of items tested. The Contractor shall replace such materials or equipment to meet the Contract requirements, unless the change is approved by the Architect.

#### 1.10 INFORMATIONAL SUBMITTALS, GENERAL

- A. Informational Submittals: Submit to Architect/Engineer three copies of data specified to be submitted for information. No action will be taken and Informational Submittals will not be returned to Contractor, unless data indicates non-compliance with the requirements of the Contract Documents, in which case Architect will return data with exceptions noted.
  - 1. Manufacturer's Installation Instructions: Provide an additional copy to be maintained at Project site.
- B. Unless otherwise specified, submittals for information include, but are not necessarily limited to, manufacturer's qualification statements, installer's qualification statements and certification letters, certificates, test reports, manufacturer's installation instructions, and source quality control reports,
- C. Certificates of Compliance:
  - 1. Where Certificates of Compliance are specified, show on each certification name and location of work, name and address of Contractor, quantity and date or dates of shipment or delivery to which certificate applies, and name of manufacturer.
  - 2. Certification: In form of letter or company standard forms.
  - 3. Certificates: Signed by officer of manufacturer.
  - 4. Laboratory Test Reports: Show date of testing, specified requirements for which testing was performed, and results of tests.

#### 1.11 SUBMITTAL DOCUMENTS TO BE MAINTAINED AT PROJECT SITE

- A. Record Documents: Keep complete set of accepted shop drawings and product data at Project site.
- B. Manufacturer's Installation Instructions: Maintain one copy of each on site, as applicable, from time of product delivery to site until installation and final cleaning of product is complete.

**PART 2 PRODUCTS** - Not Used

**PART 3 EXECUTION** - Not Used

END OF SECTION



## SECTION 01 35 13.19

### SPECIAL PROJECT PROCEDURES FOR HEALTHCARE FACILITIES

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section Includes:
  - 1. Temporary barriers and enclosures.
  - 2. Temporary controls.
- B. Related Requirements:
  - 1. Alteration Project Procedures: Section 01 35 16.

#### PART 2 PRODUCTS - Not Used

#### PART 3 EXECUTION

##### 3.01 TEMPORARY CONTROLS

- A. General: Comply with local codes, ordinances and regulations.
- B. Noise Control:
  - 1. Minimize noise at all times. All equipment shall be properly muffled. Do not operate noisy equipment after 10:00 p.m.
  - 2. Noise control, during demolition and construction, shall be of utmost importance. The Owner may order the Contractor to stop a portion of the work which they consider the cause of excessive noise.
  - 3. The Owner may order a temporary delay or postponement of certain construction activity if, in their opinion, such activity is detrimental to any patient care procedures or other affected hospital operations.
  - 4. Jackhammers: Not allowed. See Section 01 35 16.
- C. Dust and Infection Control: When construction procedures result in dust which becomes a nuisance to the Owner, private property or traffic, control said dust.
  - 1. Temporary Dust Partitions: Construct dust tight. Minimum construction to 3/8 inch gypsum board on metal studs spaced at 24 inches on center. Provide fiberglass sill seal at floor and tape all joints with duct tape. Provide 3 inch thick mineral fiber sound batt insulation on construction side of partitions.
  - 2. Dust and Infection Control Partitions in Sterile Areas: Comply with facility's infection control policies.
    - a. Fire-Rated Barriers: In occupied buildings, where temporary construction barriers are required to be installed during the construction or reconstruction of fire-resistive assemblies, temporary construction shall meet the same fire rating as would the permanent partition. Use of plastic or vinyl dust barriers in lieu of fire rated separations is prohibited. Where indicated, provide 1-hour rated temporary gypsum board partition from floor to underside of partition above with a 20-minute rated temporary door.
    - b. Non-Fire Rated Barriers: Where Drawings indicate that temporary barriers may be non-rated, provide Visqueen infection control barriers with anteroom and zip-up entryway to comply with the facility infection control policy.
    - c. Dust partitions shall include plenums and ductwork.

- d. To the greatest extent feasible, maintain negative air pressurization within the construction area. Where feasible, discharge air out of construction area with fans and filters through an exterior window.
  - e. See Section 01 35 16 for related requirements.
  - 3. Tacky Mat: First Step as manufactured by Advanced Laminated Material Applications, Inc. Provide at all dust partitions and as indicated.
- D. Debris Control: Continually police the work to prevent collection and scattering of debris uncovered, loosened, or caused by prosecution of the work.
- E. Pollution Control: Take extreme caution to prevent spilling or littering of water polluting substances. Do not dump any foreign materials into any portion of the sewer and storm sewer collection systems. Provide such labor, equipment, and materials as is necessary to remedy such pollution. No burning of debris nor any other air polluting methods or equipment will be allowed.
- F. See Section 01 10 00 Summary for related requirements.

END OF SECTION

**SECTION 01 35 16**  
**ALTERATION PROJECT PROCEDURES**

**PART 1 GENERAL**

**1.01 REQUIREMENTS INCLUDED**

- A Coordinate work of trades and schedule elements of alterations and renovation work by procedures and methods to expedite completion of the Work.
- B In addition to demolition specified in Section 02 41 19 and that specifically shown, cut, move and remove items as necessary to provide access or to allow alterations and new work to proceed. Include such items as:
  - 1. Repair or removal of hazardous or unsanitary conditions.
  - 2. Removal of abandoned items and items serving no useful purpose, such as abandoned piping, conduit and wiring.
  - 3. Removal of unsuitable or extraneous materials not marked for salvage, such as abandoned furnishings and equipment, and debris such as rotted wood, rusted metals and deteriorated concrete.
  - 4. Cleaning of surfaces, and removal of surface finishes, as needed to install new work and finishes.
- C Patch, repair and refinish existing items to remain, to the specified conditions for each material, with a workmanlike transition to adjacent new items of construction.
- D Coordination of power outages and major interruptions of progress of construction work with Owner.

**1.02 RELATED REQUIREMENTS**

- A Materials for Renovation Work: Specifications in Divisions 02 through 31.
- B Use of Premises and Work Restrictions: Section 01 10 00 Summary.
- C Cutting and Patching of New or Existing Work During Construction: Section 01 73 29 Cutting and Patching.
- D Use of Existing Utilities: Section 01 50 00 Temporary Facilities and Controls.
- E Cleaning During Construction: Section 01 50 00 Temporary Facilities and Controls.
- F Selective Demolition: Section 02 41 19.

**1.03 ALTERATIONS, CUTTING AND PROTECTION**

- A Assign the work of moving, removal, cutting and patching to trades qualified to perform the work in a manner to cause least damage to each type of work, and provide means of returning surfaces to appearance of new work.
- B Perform cutting and removal work to remove minimum necessary, and in a manner to avoid damage to adjacent work.
  - 1. Cut finish surfaces such as masonry, tile, stone flooring, plaster or metals by methods to terminate surfaces in a straight line at a natural point of division.
- C Protect existing finishes, equipment and, adjacent work that is scheduled to remain, from damage.
  - 1. Protect existing and new work from weather and extremes of temperature.
    - a. Maintain existing interior work above 60 degrees F.
    - b. Provide weather protection, waterproofing, heat and humidity control as needed to prevent damage to remaining existing work and to new work.
- D Temporary Enclosures:
  - 1. Provide temporary, dustproof enclosures to separate work areas from existing building and from areas occupied by Owner.

**1.04 COORDINATION WITH OWNER'S USE OF THE FACILITY**

- A General: Coordinate construction phasing with operation of Owner's existing facility. The Owner intends to occupy portions of the existing building throughout construction.

1. Establish effective communications with the Owner regarding Owner's operation and moving schedule. Give as much advance notice as possible, in addition to the minimums specified, for construction activities that will affect Owner's operations.
- B Utility Interruptions: Coordinate with Owner. Notify Owner 48 hours in advance of all necessary utility interruptions, including those scheduled for off hours.
- C Sequence of Construction and Remodeling:
  1. Coordination: Coordinate construction schedule with Owner's requirements.
  2. Phasing: See Phasing Plan and Phasing Notes on Drawings.

## **PART 2 PRODUCTS**

### **2.01 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING**

- A General Requirements that Work be Complete:
  1. Provide same products or types of construction as that in existing structure, as needed to patch, extend or match existing work.
    - a. Generally Contract Documents will not define products or standards of workmanship present in existing construction; Contractor shall determine products by inspection and any necessary testing, and workmanship by use of the existing as a sample of comparison.
  2. Presence of a product, finish, or type of construction, requires that patching, extending or matching shall be performed as necessary to make work complete and consistent.

## **PART 3 EXECUTION**

### **3.01 LAYING OUT WORK**

- A Verify dimensions and elevations indicated in layout of existing work. Refer discrepancies between Drawings, Specifications and existing conditions to Architect for adjustment before work affected is performed. Failure to make such notification shall place responsibility upon Contractor to carry out work in satisfactory, workmanlike manner.
- B The Contractor shall be held responsible for the location and elevation of the construction contemplated by the Construction Documents.
- C Prior to commencing work, carefully compare and check Architectural, Structural, Mechanical and Electrical Drawings, each with the other that in any way affects the location or elevation of the work to be executed, and should any discrepancy be found, immediately report the same to the Architect for verification and adjustment.

### **3.02 LOCATION OF EQUIPMENT AND PIPING**

- A Drawings showing location of equipment, piping, ductwork, etc. are diagrammatic and job conditions shall not always duplicate conditions shown. When this situation occurs, it shall be brought to the Architect's attention immediately and the relocation determined in a joint conference.

### **3.03 PATCHING EXISTING FACILITIES**

- A Existing structures, facilities, etc. that are damaged or removed due to required construction work, shall be patched, repaired or replaced, and be left in their original state of repair by the Contractor, to satisfaction of the Architect.

### **3.04 INTEGRATING EXISTING WORK**

- A Protect existing improvements from damage.
- B Contractor's operations shall be confined to the immediate vicinity of the new work and shall not in any way interfere with or obstruct the ingress or egress to and from adjacent facilities.
- C Where new work is to be connected to existing work, special care shall be exercised not to disturb or damage the existing work more than necessary. All damaged work shall be replaced, repaired and restored to its original condition at no cost to the Owner.

### **3.05 ADJUSTING**

- A Where partitions are removed, patch floors, walls and ceilings with finish materials to match existing.

1. Where removal of partitions results in adjacent spaces becoming one, rework floors and ceilings to provide smooth planes without breaks, steps or bulkheads.
2. Where extreme change of plane occurs, request instructions from Architect as to method of making transition.

B Trim and refinish existing doors as necessary to clear new floors.

### 3.06 DAMAGED SURFACES

A Patch and replace any portion of an existing finished surface which is found to be damaged, lifted, discolored, or shows other imperfections, with matching material.

1. Provide adequate support of substrate prior to patching the finish.
2. Refinish patched portions of painted or coated surfaces in a manner to produce uniform color and texture over entire surface.
3. When existing surface finish cannot be matched, refinish entire surface to nearest intersections.

### 3.07 TRANSITION FROM EXISTING TO NEW WORK

A When new work abuts or finishes flush with existing work, make a smooth and workmanlike transition. Patch work shall match existing adjacent work in texture and appearance so that the patch or transition is invisible at a distance of five feet.

1. When finished surfaces are cut in such a way that a smooth transition with new work is not possible, terminate existing surface in a neat manner along a straight line at a natural line of division, and provide trim appropriate to finished surface.

### 3.08 DUST CONTROL

A Precaution shall be exercised at all times to control dust created as a result of any operations during the construction period. If serious problems arise due to air borne dust, and when directed by Architect, operations causing such problems shall be temporarily discontinued and necessary steps taken to control the dust.

### 3.09 FIRE PROTECTION

A Maintain good housekeeping practices to reduce the risk of fire damage and injury to workmen. All scrap materials, rubbish and trash shall be removed daily from in and about the work area and shall not be permitted to be scattered to adjacent areas.

B Suitable storage space shall be provided outside the immediate building area for storing flammable materials and paints; no storage will be permitted in the building. Excess flammable liquids being used inside the building shall be kept in closed metal container and removed from the building during unused periods.

C A fire extinguisher shall be available at each location where cutting or welding is being performed. Where electric or gas welding or cutting work is done, interposed shields of incombustible material shall be used to protect against fire damage due to sparks and hot metal. When temporary heating devices are used, a watchman shall be present to cover periods when other workmen are not on the premises.

D Provide fire extinguishers in accordance with the recommendations of NFPA Bulletins Nos. 10 and 241. However, in all cases a minimum of four fire extinguishers shall be available for each building.

### 3.10 CLEANING

A Perform periodic and final cleaning as specified in Section 01 50 00 - Temporary Facilities And Controls and 01 77 00 - Closeout Procedures as follows:

1. Clean Owner-occupied areas where construction or remodeling is occurring, daily.
2. Clean areas of heavy dust production daily.
3. Clean spillage and overspray immediately.

B At completion of work of each trade, clean area and make surfaces ready for work of successive trades.

- C At completion of work in each area, provide final cleaning and return space to a condition suitable for use by Owner.

**END OF SECTION**

## SECTION 01 41 00

### REGULATORY REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 RELATED REQUIREMENTS

- A. Code Compliance: See Drawings.

##### 1.02 PERMITS AND FEES

- A. Office of Statewide Health Planning and Development (OSHPD) Requirements: OSHPD is the primary agency having jurisdiction over project design and construction within healthcare facilities.
  - 1. Licensed Contractors Declaration: Prepare and submit through Architect license documents required for OSHPD approval.
  - 2. Office of Statewide Health Planning and Development (OSHPD) Building Permit will be obtained and paid for by Owner.
  - 3. New construction and renovations shall comply with the California Building Standards Code (CBSC), 2019 Edition, California Code of Regulations (CCR), Title 24. Should any condition develop not covered by the approved Construction Documents wherein the finished Work will not comply with the CBSC, Amended Construction Documents (ACDs) detailing and specifying the required Work shall be submitted to and approved by OSHPD before proceeding with the Work.
- B. Permits, Licenses, and Certificates: See General Conditions. For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with environmental regulations bearing on performance of the Work.

##### 1.03 CODES AND ORDINANCES

- A. Compliance: All construction shall comply with all applicable codes, ordinances and regulations of federal, state, county, city, and special district agencies and jurisdictions having authority over the Project and in effect on the issue date of the Construction Documents: Applicable codes and regulations include, but are not necessarily limited to, the following:

California Building Standards Code (CBSC), 2019 Edition, California Code of Regulations, Title 24, Building Standards, Including, but not limited to:

Part 1 - 2019 California Building Standards Administrative Code (CAC)

Part 2 - 2019 California Building Code (CBC)

Part 3 - 2019 California Electrical Code (CEC)

Part 4 - 2019 California Mechanical Code (CMC)

Part 5 - 2019 California Plumbing Code (CPC)

Part 6 - 2019 California Energy Code

Part 9 - 2019 California Fire Code (CFC)

Part 10 - 2019 California Existing Building Code

Part 11 - 2019 California Green Building Standards Code

Part 12 - 2019 California Referenced Standards Code

California Code of Regulations (CCR), Title 19, Public Safety

California Code of Regulations (CCR), Title 22, Social Security

#### 1.04 OSHPD ADMINISTRATIVE REQUIREMENTS

- A. Allow access to the Project site at any time to OSHPD designated Inspector of Record (IOR) for the Project.
- B. File OSHPD Verified Report forms every three months during construction.
- C. OSHPD Approvals: In accordance with Part 1, Title 24, California Code of Regulations, all addenda and modifications to the Work requiring OSHPD approval shall be approved by the Office of Statewide Health Planning and Development (OSHPD) prior to proceeding with the work.
  - 1. Substitutions proposed for equipment and critical items require specific prior approval by OSHPD, including, but not limited to, the following:
    - a. Structural elements and connectors.
    - b. Mechanical equipment.
    - c. Bio-safety cabinets.
    - d. Fume hoods.
  - 2. Architect shall refer substitution requests requiring OSHPD approval to OSHPD for review.
- D. Include the OSHPD project number on all written test and inspection reports prepared during execution of the Work.

#### 1.05 OTHER ADMINISTRATIVE APPROVALS

- A. Compliance: General Contractor and all subcontractors shall comply with requirements of local public utility companies and state and local governmental departments, including but not necessarily limited to following:
  - Governing fire department requirements
  - Utility company requirements

#### 1.06 OTHER REGULATORY REQUIREMENTS

- A. Compliance: All contractors shall comply with all other applicable laws and regulations in effect on the issue date of the Construction Documents, including but not necessarily limited to, the following:
  - All local, state, and federal (EPA) construction stormwater pollution control regulations, and monitoring requirements
  - State and Federal Safety and Health Laws
  - United States Department of Justice – 2010 ADA Standards for Accessible Design, September 15, 2010; available at [www.ada.gov/ADAStandards\\_index.htm](http://www.ada.gov/ADAStandards_index.htm).

#### 1.07 DISCREPANCIES

- A. If discrepancies occur between Contract Documents, local codes, local utility requirements, etc., most stringent requirements shall apply.

#### 1.08 DEFERRED SUBMITTALS

- A. All items noted or listed in the Contract Documents as Deferred Approval shall not be fabricated or installed until they have been approved by OSHPD.
- B. For all Deferred Approval items provided by the Contractor, the Contractor shall be responsible for providing the details, structural calculations, engineer stamps and other necessary data or material, in accordance with OSHPD requirements and/or OSHPD review comments.



- C. The Contractor is responsible for the timely re-submission of Deferred Approval submittal packages as many times as necessary until approved by OSHPD.
- D. All items noted or listed as Deferred Submittals shall not be fabricated or installed until they have been approved by OSHPD. The Contractor is responsible for providing details, structural calculations, and other necessary data or material in accordance with OSHPD requirements, including OSHPD review comments.

**PART 2 PRODUCTS** – Not Used

**PART 3 EXECUTION** – Not Used

END OF SECTION



## SECTION 01 42 00

### REFERENCES

#### PART 1 GENERAL

##### 1.01 RELATED REQUIREMENTS

- A. Drawing or Schedule Abbreviations: As noted on Drawings or schedules.
- B. Basic Contract Definitions: As included in the Conditions of the Contract.
- C. Additional Abbreviations, Acronyms, and Definitions Specific to Work of Individual Sections: As specified in Divisions 02 through 49.

##### 1.02 ABBREVIATIONS AND ACRONYMS

- A. Reference in Contract Documents to trade associations, technical societies, recognized authorities and other institutions include following organizations which are sometimes referred to only by corresponding abbreviations or acronyms. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

AA	Aluminum Association
AAMA	American Architectural Manufacturer's Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABAA	Air Barrier Association of America
ACI	American Concrete Institute
AGC	Associated General Contractors of America
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALI	Automotive Lift Institute
ANSI	American National Standards Institute
APA	APA - The Engineered Wood Association
APSP	Association of Pool and Spa Professionals
ASABE	American Society of Agricultural and Biological Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASTM	ASTM International
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWC	American Wood Council
AWS	American Welding Society
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
CARB	California Air Resources Board
CDA	Copper Development Association, Inc.
CIMA	Cellulose Insulation Manufacturers Association
CISCA	Ceilings & Interior Systems Construction Association
CMAA	Crane Manufacturers Association of America
CPA	Composite Panel Association
CPSC	Consumer Product Safety Commission
CRA	California Redwood Association
CRI	Carpet and Rug Institute

CRSI	Concrete Reinforcing Steel Institute
CSDA	Concrete Sawing and Drilling Association
CSI	Construction Specifications Institute
DASMA	Door & Access Systems Manufacturers Association, International
DFPA	Douglas Fir Plywood Association
DHA	Decorative Hardwoods Association
DHI	Door and Hardware Institute
EPA	Environmental Protection Agency
ESDA	Electrostatic Discharge Association
FCIA	Firestop Contractors International Association
FM	Factory Mutual Insurance Company
FMG	Factory Mutual Global
FSC	Forest Stewardship Council
GA	Gypsum Association
HMMA	Hollow Metal Manufacturers Association
HUD	U.S. Department of Housing and Urban Development
IAPMO	International Association of Plumbing and Mechanical Officials
ICC	International Code Council
ICC-ES	ICC Evaluation Service
ICRI	International Concrete Repair Institute
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ISO	International Organization for Standardization
KCMA	Kitchen Cabinet Manufacturers Association
MIA	Marble Institute of America
ML/SFA	Metal Lath / Steel Framing Association
MPI	Master Painters Institute
MSJC	Masonry Standards Joint Committee
MVMA	Masonry Veneer Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NBS	National Bureau of Standards
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NIST	National Institute of Standards and Technology
NLGA	National Lumber Grades Authority
NOFMA	National Oak Flooring Manufacturer's Association
NPCA	National Paint and Coatings Association
NTMA	National Terrazzo and Mosaic Association
NWFA	National Wood Flooring Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PTI	Post-Tensioning Institute
RESNET	Residential Energy Services Network
RTI	Roof Tile Institute
SCAQMD	South Coast Air Quality Management District
SDI	Steel Deck Institute
SIPA	Structural Insulated Panel Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPC	Southern Pine Council

SPI	The Society of the Plastics Industry
SPIB	Southern Pine Inspection Bureau
SPRI	Single Ply Roofing Industry
SSMA	Steel Stud Manufacturers Association
SSPC	Society for Protective Coatings
SWI	Steel Window Institute
SWRI	Sealant, Waterproofing & Restoration Institute
TCA	Tilt-Up Concrete Association
TCNA	Tile Council of North America
TIMA	Thermal Insulation Manufacturers Association
TMS	The Masonry Society
TPI	Truss Plate Institute
UL	UL LLC
USGBC	U.S. Green Building Council
USTC&TBA	United States Tennis Court and Track Builders Association
WA	Wallcoverings Association
WCLA	West Coast Lumbermen's Association
WDMA	Window and Door Manufacturers Association
WI	Woodwork Institute
WRI	Wire Reinforcement Institute
WRCLA	Western Red Cedar Lumberman Association
WCLIB	West Coast Lumber Inspection Bureau
WTCA	Wood Truss Council of America
WWPA	Western Wood Products Association

B. Other Abbreviations and Acronyms:

AAC	Autoclaved Aerated Concrete
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
AESS	Architecturally Exposed Structural Steel
AWS	Architectural Woodwork Standards
BIM	Building Information Modeling
BUR	Built-Up Roofing
CBC	California Building Code
CFC	Chlorofluorocarbons
CFCI	Contractor Furnished, Contractor Installed
CLSM	Controlled Low-Strength Material
CMU	Concrete Masonry Unit
CPM:	Critical Path Method
CPVC	Chlorinated Polyvinyl Chloride
CS	Commercial Standard (U.S. Department of Commerce)
EIFS	Exterior Insulation and Finish System
EPDM	Ethylene Propylene Diene Monomer
EPS	Expanded Polystyrene
FRP	Fiber-Reinforced Plastic
FS	Federal Specification
GFRC	Glass-Fiber-Reinforced Concrete.
HDPE	High Density Polyethylene
HPL	High Pressure Laminate
HVAC	Heating, Ventilating and Air Conditioning
IBC	International Building Code
IAQ	Indoor Air Quality
ID	Inside Diameter
IEQ	Indoor Environmental Quality
IFGC	International Fuel Gas Code

IMC	International Mechanical Code
IPC	International Plumbing Code
IRC	International Residential Code
LEED	Leadership in Energy and Environmental Design
MDF	Medium Density Fiberboard
MERV	Minimum Efficiency Reporting Value
MIL	Military Specification
MSE	Mechanically Stabilized Earth
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electric Code (of NFPA)
NIC	Not in Contract
OC	On Center
OD	Outside Diameter
OFCI	Owner Furnished, Contractor Installed
OFOI	Owner Furnished, Owner Installed
OSB	Oriented Strand Board
PDF	Portable Document Format
PMG	Plumbing, Mechanical, and Fuel Gas
PS	Product Standard (U.S. Department of Commerce)
SDS	Safety Data Sheet
SIP	Structural Insulated Panel
SPR	Simplified Practice Recommendation (U.S. Department of Commerce)
SWMP	Storm Water Management Plan
TDO	Thermoset Decorative Overlay
TFL	Thermally Fused Laminate
TFM	Thermally Fused Melamine
TPO	Thermoplastic Polyolefin
PVC	Polyvinyl Chloride
UMC	Uniform Mechanical Code (of IAPMO)
UPC	Uniform Plumbing Code (of IAPMO)
VOC	Volatile Organic Compound
XPS	Extruded Polystyrene

### 1.03 DEFINITIONS

- A. "Accepted" and "Approved": The terms "accepted" and "approved," when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.
- B. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Architect, requested by the Architect, and similar phrases.
- C. "Drawings": The term, "Drawings," as used in the Specifications and unless otherwise identified by a qualifier, such as "shop drawings," "coordination drawings," etc., shall mean the graphic and pictorial portions of the Contract Documents as defined by the General Conditions and as enumerated in the Owner/Contractor Agreement.
- D. "Furnish": The term "furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- E. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference. Location is not limited.

- F. "Install": The term "install" describes operations at the Project site including the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- G. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.
1. The terms, "applicator" and "erector" shall mean "installer" of materials and products best described as being applied or erected.
  2. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project (unless another number is specified in a Section); being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
  3. Trades: Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
  4. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.
    - a. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.
- H. "Match Existing": The term "match existing," as used in the Specifications, refers to a requirement that new work duplicate in appearance designated or associated existing construction of the same type, to the satisfaction of the Architect or Owner
- I. "Match Existing Using Same Materials": The term "match existing using same materials," as used in the Specifications, refers to a requirement to match existing by incorporating identical products and/or duplicate materials.
- J. "Project Site" is the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- K. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.
- L. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- M. "Specifications": The term, "Specifications," as used in the Project Manual, unless otherwise identified by a qualifier, such as "manufacturer's specifications," etc., shall mean the written requirements portion of the Contract Documents as defined by the General Conditions and as enumerated in the Owner/Contractor Agreement, consisting of Divisions 01 through 49.

- N. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

#### 1.04 STANDARDS REFERENCED BY SPECIFICATIONS

- A. Reference Standards: For products or workmanship specified by association, trade or federal standards, comply with requirements of specified standard, except when more stringent requirements are specified or are required by codes in effect in the jurisdiction governing the Project.
1. No provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change duties and responsibilities of Owner, Contractor or Architect or any of their consultants, agents or employees from those set forth in Contract Documents, nor shall it be effective to assign to Architect or any of Architect's consultants, agents or employees any duty or authority to supervise or direct furnishing or performance of work or any duty or authority to undertake responsibilities contrary to provisions of General and Supplementary Conditions.
  2. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the Architect for a decision before proceeding.
- B. Effective Date: Version of standard referenced shall be that current and in effect as of the date of issue of the Contract Documents, with the following exceptions:
1. For standards incorporated into an applicable code by reference which includes edition date, and no specific edition date is specified by these Project Specifications, the edition of such standard as adopted or referenced by code shall govern.
  2. For standards incorporated into an applicable code by reference which includes edition date, but for which a different specific edition date is specified by these Project Specifications, the edition referenced in the Specifications shall govern, except that where requirements of the edition referenced by code are more stringent, such requirements of the edition of the standard adopted or referenced by code shall govern. In no case shall a reference to a standard in these Specifications be considered to supersede the minimum requirements of any applicable code or of any standard referenced by an applicable code. But requirements may be specified that are in addition to and beyond the minimum requirements of the governing codes by referencing other editions of standards.
  3. For standards not adopted or referenced by code but referenced by edition date in these Specifications, the version referenced in the Specifications shall govern over a later version adopted by an association or trade group and in effect as of the date of issue of the Contract Documents.
- C. Guide References and Standard Practices: Where guide references, standard practices, and similar references published by associations and trade groups and written in non-mandatory language are specified, they shall establish the general quality of manufacturing or construction trade practice which the Work is intended to meet. Follow the recommendations of such reference documents except as otherwise specified in this Project Manual or required by applicable code.
1. Where Specifications incorporate such recommendations by direct reference, the referenced portion of the guide reference or standard practice shall be considered to have the full force of a Reference Standard, as specified in this Section.



- D. Copies: When required by individual sections, obtain copy of standard. Maintain copy at job site during work governed by reference standard.
  - 1. ASTM International Standards: For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org).

#### 1.05 UL ONLINE CERTIFICATIONS DIRECTORY

- A. Where UL design numbers are referenced on Drawings, assemblies shall comply with the requirements listed by the referenced UL design, in addition to requirements of applicable specification sections.
- B. UL Online Reference Database: UL Product iQ; <https://iq.ulprospector.com>.

**PART 2 PRODUCTS** – Not Used

**PART 3 EXECUTION** – Not Used

END OF SECTION



## SECTION 01 45 00

### QUALITY CONTROL

#### PART 1 GENERAL

##### 1.01 RELATED REQUIREMENTS

- A. Structural Observation and Special Inspection Requirements: General Notes on Structural Drawings.

##### 1.02 DEFINITIONS

- A. Quality Assurance: Administrative and procedural requirements for proactive activities to ensure the quality of construction before and during the execution of the Work.
  - 1. Activities and Requirements Included:
    - a. General qualification requirements for manufacturers, suppliers, installers, fabricators, and delegated designers.
    - b. Administrative and procedural requirements for field services provided by manufacturer's representatives.
    - c. General requirements for mockups and field samples constructed, applied, or assembled at the site for review and use as a quality standard.
  - 2. The term "Quality Assurance" as used in the CBC or in CBC-referenced standards may include "Quality Control" activities as defined by this Specification. Such possible discrepancies in terminology do not modify or eliminate any Quality Assurance or Quality Control requirement in the CBC or in these Project Specifications.
- B. Quality Control: Administrative and procedural requirements for reactive activities to evaluate completed activities and elements for conformance with the specified requirements.
  - 1. Activities and Requirements Included:
    - a. Correction of defective construction.
    - b. Contractor quality control.
    - c. Testing and inspection services.
    - d. Testing laboratory services.
    - e. Code-required special inspections and procedures.
  - 2. Where requirements of the CBC or of CBC-referenced standards are referred to in the code as "Quality Assurance" but meet this definition of "Quality Control," "Quality Control" activities and requirements of this Project Specification shall be taken to mean the same as "Quality Assurance" as used in the CBC.

##### 1.03 CONTRACTOR QUALITY CONTROL

- A. Quality Control: Establish system to perform sufficient inspection and tests of all items of work, including that of subcontractors, to ensure conformance to Contract Documents for materials, workmanship, construction, finish, functional performance and identification.
  - 1. Control System:
    - a. Establish for all construction except where Contract Documents provide for specific compliance tests by testing laboratories and engineers employed by Owner.
    - b. Specifically include all testing required by various sections of Specifications.
- B. Contractor's Quality Control System: Means by which Contractor assures himself that construction complies with requirements of Contract Documents. Controls shall be adequate to cover all construction operations and keyed to proposed construction schedule.

- C. Records: Maintain correct records on appropriate form for all inspections and tests performed, instructions received from Architect and actions taken as result of those instructions.
  - 1. Records: Include evidence that required inspections or tests have been performed (including type and number of inspections or tests, nature of defects, causes for rejection, etc.) proposed or directed remedial action, and corrective action taken.
  - 2. Document inspections and tests as required by each section of Specifications.

#### 1.04 TESTING, GENERAL

- A. Provide equipment and facilities as required for conducting field tests and for collecting and forwarding samples.
  - 1. Do not use materials or equipment represented by samples until tests, if required, have been made and materials or equipment found to be acceptable.
  - 2. Do not incorporate any product into work which becomes unfit for use after acceptance thereof.
- B. Testing: Materials or equipment proposed for use may be tested at any time during their preparation or use. Furnish required samples without charge and give sufficient notice of placing of orders to permit testing. Products may be sampled either prior to shipment or after being received at site of work.
- C. Tests: Made by accredited testing laboratory selected by Design-Builder. Except as otherwise provided, sampling and testing of materials and laboratory methods and testing equipment shall be in accordance with latest standards and tentative methods of ASTM.
  - 1. Specific information concerning testing methods, sample sizes, etc., is included under applicable sections of specifications.
  - 2. Any modification of, or elaboration on, these test procedures included for specific materials under their respective sections in specifications shall take precedence over these procedures.

#### 1.05 TESTS AS DIRECTED BY DESIGN-BUILDER

- A. Control Tests of Concrete Work: At such times and in such numbers as specified in Section 03 30 53 Miscellaneous Cast-In-Place Concrete.
- B. Control Tests of Welding: At such times and in such numbers as specified in Section 05 12 00 Structural Steel Framing; also the following sections:
  - 1. 05 40 00 Cold-Formed Metal Framing.
- C. Concrete Floor Slab Vapor Emission, Relative Humidity, Alkalinity and Bond Testing: At such times and in such numbers as specified in Section 09 05 61 Common Work Results for Flooring Preparation.

#### 1.06 OTHER TESTING

- A. Following Testing: Performed at expense of installing contractor:
  - 1. Any additional tests required because of any tests that fail subject to following conditions:
    - a. Quantity and Nature of Tests: Determined by Architect.
    - b. Tests: Taken in presence of Architect.
    - c. Proof of Noncompliance: Contractor liable for corrective action that Architect feels is required including complete removal and replacement of defective material.
  - 2. Material Substitution: Any tests of material or equipment offered as substitute for specified item on which test may be required in order to prove its compliance with specifications.

- B. Subcontractors: May have tests performed on material and equipment for own information and job control so long as Design-Builder does not assume responsibility for costs or for giving them consideration when appraising quality of materials.

#### 1.07 TEST REPORTS

- A. Reports of tests made by testing laboratories shall be distributed by testing laboratory as follows:
  - 1 Copy – Design-Builder
  - 1 Copy - Applicable Supplier or Subcontractor
  - 1 Copy - Owner
  - 1 Copy - Applicable Engineer
  - 1 Copy - Architect
  - Other Copies - As Directed

#### 1.08 CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

- A. Regulatory Requirements: Special inspections will be provided in accordance with the CBC.
- B. When required by Building Official, special inspection services will be provided and paid by Owner.
- C. Special Inspector: Qualified person acceptable to Building Official with jurisdiction over this project to inspect particular type of construction or operation requiring special inspection.
- D. Special Inspection Reports:
  - 1. Distribution:
    - a. Building official: One
    - b. Design-Builder: One
    - c. Architect: One
    - d. Structural Engineer: One
    - e. Contractor: One
    - f. Owner: One
  - 2. Final Report: Special Inspector will submit and distribute signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance with the approved Drawings and Specifications and the applicable workmanship provisions of the building code adopted by the local building code jurisdiction.

**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 SUMMARY

- A Section Includes:
  - 1. Temporary utilities.
  - 2. Construction facilities.
  - 3. Temporary construction.
  - 4. Construction aids.
  - 5. Temporary barriers and enclosures.
  - 6. Temporary controls.
- B Related Requirements:
  - 1. Utility Usage: General Conditions, Article 56.
  - 2. Work Restrictions: Section 01 10 00 Summary.
  - 3. Alteration Project Procedures: Section 01 35 16.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

3.01 TEMPORARY ELECTRICITY AND LIGHTING

- A Service and Distribution:
  - 1. Contractor may connect to existing electrical power system for source of temporary electricity and lighting. Coordinate location and means of connection with Owner.
  - 2. Provide temporary electrical service and temporary wiring, outlets, lights, etc. as required for construction power and lighting during construction period.
  - 3. Properly ground service and distribution system in accordance with NEC. Provide ground fault interrupters as required by code.
  - 4. Remove temporary electrical service and wiring upon completion of work.
- B Temporary Power Distribution:
  - 1. Supplement existing system as required. Provide minimum of one double duplex 120V outlet for every 100 lineal feet of temporary loop.
  - 2. Each Contractor: Furnish extension cords necessary to convey electricity from temporary loop outlets to locations of work.
  - 3. Special Power Required for Welders or Other Special Equipment: Provided by contractor requiring such power.
  - 4. Distribution equipment and wiring devices for temporary power and lighting need not be new, however, installation shall conform to safe general practice as required by OSHA.
- C Temporary Lighting:
  - 1. Provide one light for every interior room regardless of square footage area except closets and pipe chases. In larger rooms, provide one light for every 750 square feet.
  - 2. Each Contractor: Provide plug-in portable lights as required for task lighting.
- D Use of Permanent Systems:
  - 1. Existing permanent system and, where applicable, new or modified components of permanent system installed under this Contract, may be used as necessary for power and light.
  - 2. Be responsible for any damage to permanent wiring or fixtures as result of temporary use.
  - 3. Permanent branch circuit wiring may be used to supply pigtail lights if protected by properly sized circuit breaker or fuse. Do not use permanent receptacles for construction power. Replace receptacles and device plates showing wear or abuse.
  - 4. Provide lamps necessary to temporarily light work in permanently installed fixtures.
  - 5. Clean permanently installed light fixtures that are used for temporary lighting during construction using methods and materials recommended by the manufacturer.

6. Remove lamps used temporarily in permanent fixtures and replace with new lamps at completion of work.

### 3.02 TEMPORARY HEAT, VENTILATION, AND ENCLOSURES

- A Temporary Heat: Provide temporary heat necessary for execution of Work. Install, maintain and operate temporary heating apparatus in manner to facilitate work, to comply with ambient environmental limitations for installation of new products and materials required by the specifications and manufacturer's installation instructions, to enable work to continue, and to ensure finished work will not be damaged by cold or freezing.
- B Enclosures: Provide temporary enclosures necessary for holding temporary heat for masonry and concrete work, and for thawing frozen ground.
- C Use of Permanent System:
  1. In using permanent heating system, assume complete responsibility for its proper operation and for any damage that may occur to heating apparatus or any phase of work except such wear and tear that would ordinarily result from normal usage.
  2. At completion and before work is accepted by Owner, clean air vents and coils, clean cleanable filters and replace replacement air filters.
  3. If permanent heating system is used during construction, Contractor shall remain responsible for full mechanical guarantee from date of Notice of Acceptance of total Project by Owner.

### 3.03 TEMPORARY WATER

- A Existing System: Contractor may connect to existing water distribution system for source of temporary water.
  1. Coordinate location and means of connection with Owner.
  2. Provide temporary connection, plumbing, piping, etc. necessary to convey same to places needed.

### 3.04 TEMPORARY SANITARY FACILITIES

- A Temporary Toilet Facilities: Provide and maintain, in neat and sanitary condition, adequate temporary self-contained chemical toilet facilities for use of employees engaged on work, in compliance with requirements of applicable codes, regulations, laws and ordinances. Locate units within fenced/screened area.
  1. Toilets in existing buildings shall not be used.

### 3.05 FIELD OFFICE AND OTHER TEMPORARY STRUCTURES

- A Field Office: Provide and maintain suitable temporary field office.
  1. Telephone and Fax Service: Install telephone with answering machine and fax machine in field office. Pay for installation, maintenance, removal and other charges for use of telephone.
    - a. Make office and telephone/fax machine available for use by Owner and Architect.
  2. Photocopier: Install at least one photocopying machine in field office.
  3. Maintain current set of Drawings at site and make available for use by Architect.
- B Temporary Structures: Provide temporary structures and storage areas as required.
  1. Remove offices and other temporary structures from site upon completion of work.
  2. Locate on site in orderly manner as coordinated with Owner.

### 3.06 TEMPORARY PROTECTIVE FACILITIES

- A Provide and maintain protective devices and facilities for protection of public and general protection of workmen on project.
  1. Provide warning signs against hazards created by such features of construction as protruding nails, hoists, well holes, window openings, stairways and falling materials.
  2. Provide and maintain fire extinguishers and active fire hydrants where required. Maintain fire lanes to hydrants and other equipment as necessary for proper fire protection during construction.



3. Provide temporary walks, roadways, trench covers, barricades, bulkheads, railings, danger lights and signals, etc. required for work by applicable safety laws and building codes.
4. Maintain temporary protective facilities in good condition throughout term of work. Remove at completion of work. Repair and replace work damaged thereby.

### 3.07 PROTECTION FOR WORK IN PLACE

- A Work in Place: When subject to injury because of operations being carried on adjacent, cover, board up, or substantially enclose with adequate protection.
1. Block and board heads, jambs and sills of permanent openings used as thoroughfares for introduction of work and materials.
  2. Construct forms of protection in manner that, upon completion, entire work will be delivered to Owner in undamaged condition.

### 3.08 ACCESS

- A Limit access to necessary routes to perform the work.
1. Coordinate access with Owner.
  2. See Section 01 10 00 for limitations on access to site.

### 3.09 TEMPORARY CONTROLS

- A General: Comply with local codes, ordinances and regulations.
- B Noise Control:
1. Minimize noise at all times. All equipment shall be properly muffled. Do not operate noisy equipment after 10:00 p.m.
  2. Noise control, during demolition and construction, shall be of utmost importance. The Owner may order the Contractor to stop a portion of the work which they consider the cause of excessive noise.
  3. The Owner may order a temporary delay or postponement of certain construction activity if, in their opinion, such activity is detrimental to any patient care procedures or other affected hospital operations.
  4. Jackhammers: Not allowed.
- C Dust Control: When construction procedures result in dust which becomes a nuisance to the Owner, private property or traffic, control said dust.
1. Temporary Dust Partitions: Construct dust tight. Minimum construction to 3/8 inch gypsum board on metal studs spaced at 24 inches on center. Provide fiberglass sill seal at floor and tape all joints with duct tape. Provide 3 inch thick mineral fiber sound batt insulation on construction side of partitions.
  2. Tacky Mat: First Step as manufactured by Advanced Laminated Material Applications, Inc. Provide at all dust partitions and as indicated.
  3. Provide polyethylene sheeting from top of ceiling to underside of deck above during construction.
- D Debris Control: Continually police the work to prevent collection and scattering of debris uncovered, loosened, or caused by prosecution of the work.
- E Pollution Control: Take extreme caution to prevent spilling or littering of water polluting substances. Do not dump any foreign materials into any portion of the sewer and storm sewer collection systems. Provide such labor, equipment, and materials as is necessary to remedy such pollution. No burning of debris nor any other air polluting methods or equipment will be allowed.
- F See Section 01 10 00 Summary for related requirements.

### 3.10 CLEANING OF THE WORK

- A General: Maintain Project and site in clean and orderly condition. Periodically clean interior areas. Regularly remove waste materials, debris and rubbish from site.

- B Interior Areas: Clean prior to start of finish work and continue cleaning as required. Control cleaning operations so that dust and other particles will not adhere to newly coated surfaces.

**END OF SECTION**

## SECTION 01 60 00

### PRODUCT REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section Includes:
  - 1. Common product requirements.
  - 2. Product options.
  - 3. Product delivery requirements.
  - 4. Product storage and handling requirements.
  
- B. Related Requirements:
  - 1. Low-Emitting Material Requirements: Section 01 61 65.
  - 2. Owner-Supplied Products: Section 01 64 00.
  - 3. Examination and Acceptance of Substrates and In-Place Construction to Receive Product Installation: Section 01 71 16 Acceptance of Conditions.
  - 4. General Product Installation Requirements: Section 01 73 19 Installation.
  - 5. Product Warranties and Operation and Maintenance Manuals: Section 01 78 00 Closeout Submittals.

##### 1.02 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

##### 1.03 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

##### 1.04 TRANSPORTATION AND HANDLING

- A. Transportation: Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry.
  
- B. Handling: Provide equipment and personnel to handle products by methods to prevent soiling or damage. Comply with manufacturer's written instructions.
  
- C. Hazard Communication Safety Data Sheets (SDS): During product transportation and handling, comply with controls specified on SDS for each product required by the OSHA Hazard Communications Standard (HCS) to have a SDS.
  - 1. Each SDS shall be prepared within the previous five years.
  - 2. Subcontractor or Supplier: Provide one copy of SDS to Contractor with each delivery of subject product to site.
  - 3. SDS Data: Provide in uniform format mandated by the HCS. Maintain one copy of each on site, as applicable, from time of product delivery to Project site until installation and final cleaning of product is complete. Maintain SDS data on file at Project site in location readily accessible for emergency reference by all employees on site.

- 4. Compliance with SDS: Sole responsibility of the Contractor. Architect will neither review content of SDS nor monitor compliance.
- D. Delivery: Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
- E. Inspection: Inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
  - 1. Reject damaged and defective items.
- F. Each Subcontractor: Be responsible for hoisting and stocking of its materials and equipment on site.
  - 1. Material Stocked on Floors: Palletized or packaged in appropriate containers on floor by floor basis.
  - 2. Material Stocking: Coordinated by Contractor's superintendent.

#### 1.05 STORAGE AND PROTECTION

- A. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment. Store products in accordance with manufacturer's recommendations, with seals and labels intact and legible. Store sensitive products in weathertight enclosures.
  - 1. Store loose granular materials on solid surfaces in well drained area; prevent mixing with foreign matter.
  - 2. Store materials in a manner that will not endanger Project structure.
  - 3. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
- B. Exterior Storage Protection:
  - 1. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
  - 2. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
- C. Inspection: Arrange storage to provide access for inspection. Periodically inspect to ensure products are undamaged, and are maintained under recommended conditions.

#### 1.06 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve supplier and subcontractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

## **PART 2 PRODUCTS**

### **2.01 COMMON PRODUCT REQUIREMENTS**

- A. Products: Include material, equipment and systems.
  1. Comply with Specifications and referenced standards as minimum requirements.
  2. Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
    - a. Salvaged and Reused Products: Do not use materials and equipment removed from existing structure, except as specifically required, or allowed, by Contract Documents.
  3. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
- B. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- C. Components of Specified UL Design Assemblies: Products supplied shall be limited to products listed in UL Fire Resistance Directory for specified assembly. See Section 01 42 00.
- D. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

### **2.02 PRODUCT OPTIONS**

- A. Product Selection Procedures:
  1. The Contract Documents and governing regulations govern product selection.
  2. The Design/Builder may accept or reject any and all products proposed by suppliers and subcontractors, subject only to reasonable objection by the Owner, compliance with applicable codes and regulations, and to review and verification by the Architect that the selected product complies with the requirements of the design as documented on the Drawings and in the Specifications, as approved by the authorities having jurisdiction.
  3. Specification conventions and general limitations on product options within the Specifications are defined by this Article.
- B. Compatibility of Options: If option is given of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- C. Products Specified by Reference Standards or by Description Only: Provide any product meeting those standards.
  1. 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.
  2. Compliance with Standards, Codes, and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.

3. Where Product Data, Samples, or both, are specified to be submitted, review and acceptance by Architect is required for verification that Contractor's product selection complies with Contract requirements.
- D. Nonproprietary Specifications: When 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 provide any available product that complies with Contract requirements, including, but not limited to, specified reference standards and product descriptive and performance specifications.
1. Where Product Data, Samples, or both, are specified to be submitted, review and acceptance by Architect is required for verification that Contractor's product selection complies with Contract requirements.
- E. Products Specified by Naming One or More Acceptable Manufacturers: Provide products of one or more of named manufacturers complying with specified reference standards and product descriptive and performance specifications; and where product is specified by naming product make or model number or other designation proprietary to one of the named Acceptable Manufacturers, provide either that product or an alternative product by one of the other named Acceptable Manufacturers that is comparable or superior to the named product in type, function, dimension, in-service performance, physical properties, appearance, quality, performance, and other significant characteristics.
1. Products of Acceptable Manufacturers are subject to other requirements of Specifications for specified product, including, but not limited to, specified reference standards and product descriptive and performance specifications.
  2. Where Product Data, Samples, or both, are specified to be submitted, review and acceptance by Architect is required for verification that Contractor's product selection from products available from Acceptable Manufacturers complies with Contract requirements, and for acceptance of product options and accessories proposed by Contractor to be furnished with product.
- F. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "Basis of Design," including make or model number or other designation, provide named product.
1. Basis-of-Design Manufacturers and Products may be considered to be approved by Architect. Where Product Data, Samples, or both, are specified to be submitted, review and acceptance by Architect is required only for verification that Contractor is providing Basis-of-Design Product, and for selection and acceptance of product options and accessories not specified, or specified to be "as selected by Architect," and proposed by Contractor to be furnished with product.
  2. Where Basis-of-Design product specification is supplemented by descriptive specifications, performance specifications, reference standard specifications, or any combination of these, these specify the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics intended by the design to be provided by the Basis-of-Design product, based on its manufacturer's published literature, and are to be used, in part, as a basis for evaluating Comparable Products. If, in the opinion of the Contractor, the Basis-of-Design product does not itself wholly comply with the descriptive, performance, or reference standard specifications, Contractor shall notify the Architect as early as possible of this apparent discrepancy and the basis for this opinion. The Architect will then review the information supplied by the Contractor and take one of the following actions:
    - a. If the Architect determines that there is no significant discrepancy within the Specifications, the Architect will respond to that effect.
    - b. If the Architect determines that there is a significant discrepancy between the Basis-of-Design product specification and the descriptive, performance, or reference standard specifications, the Architect may issue a Supplemental Instruction, retaining the Basis-

- of-Design product selection and modifying or waiving the descriptive, performance, or reference standard specifications as required to make them consistent with the Basis-of-Design product specification.
- c. If the Architect determines that there is a significant discrepancy between the Basis-of-Design product specification and the descriptive, performance, or reference standard specifications, the Architect may revise the Specification, changing the Basis-of-Design product selection to comply with the descriptive, performance, or reference standard specifications.
3. Where a Basis-of-Design Manufacturer is specified, but no Basis-of-Design product is named, provide product by named manufacturer complying with specified reference standards and product descriptive and performance specifications.
    - a. Where Product Data, Samples, or both, are specified to be submitted, review and acceptance by Architect is required for verification that Contractor's product selection from products available from Basis-of-Design Manufacturer complies with Contract requirements, and for acceptance of product options and accessories proposed by Contractor to be furnished with product.
  4. Contractor Proposal to Provide Product Other Than Basis-of-Design Product: The Architect will review products proposed as substitutions for Basis of Design products upon the Design/Builder's request for compliance with design intent and code requirements.
    - a. The proprietary product specification, in conjunction with specified reference standards and product descriptive and performance specifications, establishes the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics intended by the design, and, in the event of a request for substitution or submittal of a Comparable Product, will be used for purposes of evaluating products of other manufacturers proposed.
    - b. If a Specification Section includes a reference to Comparable Products by other Acceptable Manufacturers, Architect will consider Contractor's request for comparable product based on the following data to be provided by the proposing product supplier:
      - 1) Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
      - 2) Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
      - 3) Evidence that proposed product provides specified warranty.
      - 4) List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
      - 5) Samples, if requested.
    - c. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.
    - d. Comparable Product Request Submittal: Submit for review, acceptance and return in accordance with Section 01 33 00. Include the following:
      - 1) Identify Basis-of-Design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
      - 2) Product Data, including drawings and descriptions of products and fabrication and installation procedures.

- 3) Samples, where applicable or requested.
  - 4) Certificates, test reports, research reports, and qualification data, where applicable or requested.
  - 5) Reference UL Fire Resistance Directory design number if applicable.
  - 6) List availability of maintenance services and replacement materials.
  - 7) Use Basis-of-Design product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
  - 8) When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.
- f. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.
- F. Products Specified by Naming Only One Sole Source Manufacturer: No option, no substitution allowed.
- G. 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.
1. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.
  2. Where Specifications require compliance with performance requirements alone, select any product that complies with these requirements and is recommended by the manufacturer for the application indicated.
  3. Where proprietary or Basis-of-Design product Specifications also include performance requirements, proposed substitutions must meet specified performance requirements as a minimum.
    - a. If Contractor believes specified or basis-of-design product does not meet specified performance requirements, Contractor shall obtain clarification of apparent discrepancy from Architect. If Architect confirms discrepancy, Architect will determine if specified performance requirements or performance provided by proprietary or basis-of-design product will govern. If Architect determines that specified performance requirements govern, a Change Order modifying the proprietary or basis-of-design product specification will be issued.
- H. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.
1. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category.
- I. Where products or product characteristics are accompanied by the term "as selected," Architect will make selection.
1. 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, including proprietary requirements, if applicable. The Architect will select the color, pattern, and texture from the product line selected.



- J. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with applicable requirements in Division 01 and individual Specification Sections.
  - 1. Select products for which sustainable design documentation submittals are available from manufacturer.

**PART 3 EXECUTION – Not Used**

END OF SECTION



## SECTION 01 61 65

### LOW-EMITTING MATERIAL REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section Includes:
  - 1. Common VOC requirements for adhesives.
  - 2. Common VOC requirements for sealants.
  - 3. Common VOC requirements for paints and coatings.
  - 4. VOC and formaldehyde limitations for engineered wood and wood-based panel products.
  - 5. Common low-emitting requirements for flooring systems.
  - 6. Common VOC requirements for insulation.
  
- B. Related Requirements:
  - 1. Common Product Requirements, General: Section 01 60 00 Product Requirements.
  - 2. Joint Sealants: Section 07 92 00.
  - 3. Paints and Coatings: Section 09 91 23 Interior Painting.
  - 4. Sections in Divisions 01 through 49 specify indoor environmental quality requirements specific to the Work of each of those Sections.

##### 1.02 REFERENCES

- A. General Requirements: Refer to Section 01 42 00.
  
- B. Abbreviations and Acronyms:
  - 1. ATCM: Airborne Toxic Control Measure.
  - 2. CARB: California Air Resources Board.
  - 3. IM: Industrial Maintenance.
  - 4. SDS: Safety Data Sheet.
  - 5. ULEF: Ultra-Low-Emitting Formaldehyde.
  - 6. VOC: Volatile Organic Compound.
  
- C. Definitions: Terms defined by the LEED Reference Guide for Building Design and Construction apply to this Section. Meaning of certain terms as used in this Specification are as follows.
  - 1. Adhesive: Any substance used to bond one surface to another by attachment. Includes adhesive bonding primers.
  - 2. Interior: For purposes of this Section, "interior" shall mean inside the weatherproofing system and applied on-site.
  - 3. Sealant: Any material with adhesive properties that is formulated primarily to fill, seal, or waterproof gaps or joints between two surfaces. Sealants include sealant primers and caulks.
  
- D. Reference Standards: Comply with the following except as otherwise specified in this Project Manual.
  - 1. California Air Resources Board (CARB); [www.arb.ca.gov](http://www.arb.ca.gov):
    - a. CARB 93120 ATCM.
    - b. CARB SCM - Suggested Control Measure for Architectural Coatings, 2007.
  - 2. California Department of Public Health (CDPH); [www.cdph.ca.gov](http://www.cdph.ca.gov):
    - a. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.2.

3. South Coast Air Quality Management District (SCAQMD); [www.aqmd.gov](http://www.aqmd.gov):
  - a. Rule No. 1113 – Architectural Coatings, amended February 5, 2016.
  - b. Rule No. 1168 – Adhesive and Sealant Applications, amended October 6, 2017.

### 1.03 SUBMITTALS

- A. Particleboard and MDF: Submit third-party certification that formaldehyde emissions comply with standards of CARB Air Toxic Control Measure (ATCM) for Formaldehyde Emissions from Composite Wood Products, and with ANSI A208.1 or A208.2 as applicable, when tested in accordance with ASTM E1333.
  1. Provide documentation that composite wood and agrifiber products contain no urea-formaldehyde resins.

## PART 2 PRODUCTS

### 2.01 INHERENTLY NONEMITTING SOURCES

- A. Products are considered fully compliant without VOC emissions testing if they do not include integral organic-based surface coatings, binders, or sealants. Such products include, but are not limited to, the following:
  1. Stone.
  2. Ceramics.
  3. Powder-coated metals.
  4. Plated or anodized metal.
  5. Glass.
  6. Concrete.
  7. Clay brick.
  8. Unfinished or untreated solid wood flooring.

### 2.02 FORMALDEHYDE LIMITS FOR MATERIALS

- A. Formaldehyde limits shall be as follows:
  1. Hardwood Plywood: 0.05 ppm.
  2. Particleboard: 0.09 ppm.
  3. Medium-Density Fiberboard (MDF): 0.11 ppm.
  4. Thin MDF: 0.13 ppm.

### 2.03 ADHESIVES

- A. Provide low VOC types as recommended by the manufacturer of the material being installed. Adhesives shall comply with SCAQMD Rule 1168.
- B. VOC emissions shall be tested and compliant in accordance the CDPH Standard Method.
- C. Interior Applications: For interior applications use adhesives that comply with the following limits for VOC content when calculated according to SCAQMD Method 304, 316A or 316B:
  1. Architectural Applications:
    - a. Carpet Pad Adhesives: 50 g/L.
    - b. Ceramic, Glass, Porcelain, and Stone Tile Adhesives: 65 g/L.
    - c. Cove Base Adhesives: 50 g/L.
    - d. Gypsum Board and Panel Adhesives: 50 g/L.
    - e. Multipurpose Construction Adhesives: 70 g/L.
    - f. Rubber Floor Adhesives: 60 g/L.
    - g. Structural Glazing Adhesives: 100 g/L.

- h. Structural Wood Member Adhesives: 140 g/L.
  - i. Subfloor Adhesives: 50 g/L.
  - j. VCT and Asphalt Tile Adhesives: 50 g/L.
  - k. Wood Flooring Adhesive: 100 g/L.
  - l. All Other Indoor Floor Covering Adhesives: 50 g/L.
  - m. Computer Diskette Manufacturing Adhesive: 350 g/L.
  - n. Contact Adhesive: 80 g/L.
  - o. Edge Glue Adhesive: 250 g/L.
  - p. Plastic Welding Cement:
    - 1) ABS Welding Cement: 325 g/L.
    - 2) ABS to PVC Transition Cement: 510 g/L.
    - 3) CPVC Welding Cement: 490 g/L.
    - 4) PVC Welding Cement: 510 g/L.
    - 5) All Other Plastic Welding Cements: 250 g/L.
  - q. Rubber Vulcanization Adhesive: 250 g/L.
  - r. Special Purpose Contact Adhesive: 250 g/L.
  - s. Thin Metal Laminating Adhesive: 780 g/L.
  - t. Tire Tread Adhesive: 100 g/L.
  - u. Top and Trim Adhesive: 250 g/L.
  - v. Waterproof Resorcinol Glue: 250 g/L.
  - w. All Other Adhesives: 250 g/L.
2. Substrate Specific Adhesives:
    - a. Metal to Metal Adhesives: 30 g/L.
    - b. Plastic Foam Adhesives: 50 g/L.
    - c. Porous Materials (Except Wood): 50 g/L.
    - d. Wood Glues: 30 g/L.
    - e. Fiberglass Adhesives: 80 g/L.
    - f. Reinforced Plastic Composite Adhesives: 250 g/L.
  3. Adhesive Primers:
    - a. Plastic: 550 g/L.
    - b. Pressure Sensitive: 250 g/L.
    - c. Traffic Marking Tape: 150 g/L.
    - d. Vehicle Glass: 250 g/L.
- C. Exterior Applications: Adhesives applied on site shall meet the VOC limits of CARB SCM and SCAQMD Rule 1168. Comply with the following limits for VOC content when calculated according to the CDPH Standard Method.
1. Building Envelope Membrane Adhesive: 250 g/L.
  2. Ceramic, Glass, Porcelain, and Stone Tile Adhesives: 65 g/L.
  3. Roofing Adhesives:
    - a. For Single Ply Roof Membranes: 250 g/L.
    - b. For Other Roofing Types: 250 g/L.
  4. Structural Glazing Adhesives: 100 g/L.
  5. All Other Outdoor Floor Covering Adhesives: 150 g/L.
  6. Adhesive Primers for Exterior Applications:
    - a. Plastic: 550 g/L.
    - b. Pressure Sensitive: 250 g/L.
    - c. Traffic Marking Tape: 150 g/L.
    - d. Vehicle Glass: 250 g/L.

## 2.04 SEALANTS

- A. General Requirements for Sealants: Section 07 92 00.
- B. VOC emissions shall be tested and compliant in accordance the CDPH Standard Method.

- C. Interior Applications: For interior applications, use sealants that comply with the following limits for VOC content in accordance with SCAQMD Rule 1168:
1. Architectural Applications:
    - a. Clear, Paintable, and Immediately Water-Resistant Sealant: 250 g/L.
    - b. Foam Insulation: 250 g/L.
    - c. Foam Sealant: 250 g/L.
    - d. Tile Grout: 250 g/L.
    - e. Non-Staining Plumbing Putty: 250 g/L.
    - f. Potable Water Sealant: 250 g/L.
    - g. All Other Architectural Sealants: 250 g/L.
  2. Sealant Primers:
    - a. Architectural Applications:
      - 1) Sealant Primers for Nonporous Substrates: 250 g/L.
      - 2) Sealant Primers for Porous Substrates: 775 g/L.
- D. Exterior Applications: Sealants applied on site shall meet the VOC limits of CARB SCM and SCAQMD Rule 1168. Comply with the following limits for VOC content when calculated according to the CDPH Standard Method.
1. Clear, Paintable, and Immediately Water-Resistant Sealant: 250 g/L.
  2. Foam Insulation: 250 g/L.
  3. Foam Sealant: 250 g/L.
  4. Tile Grout: 250 g/L.
  5. Roadway Sealant: 250 g/L.
  6. Roofing Sealants:
    - a. For Single Ply Roof Membranes: 450 g/L.
    - b. For Other Roofing Types: 300 g/L.
  7. Marine Deck Sealant: 760 g/L.
  8. All Other Sealants: 420 g/L.
  9. Sealant Primers for Exterior Applications:
    - a. Architectural Applications:
      - 1) Sealant Primers for Nonporous Substrates: 250 g/L.
      - 2) Sealant Primers for Porous Substrates: 775 g/L.
    - b. Marine Deck: 760 g/L.
    - c. Modified Bituminous: 500 g/L.
    - d. All Other Sealant Primers: 750 g/L.

## 2.05 PAINTS AND COATINGS

- A. General Requirements for Paints and Coatings: Section 09 91 23.
- B. Paints, stains, and coatings wet-applied on site shall comply with the following limits for VOC content, less water and less exempt compounds, when calculated according to the CDPH Standard Method:
1. Bond Breakers: 350 g/L.
  2. Building Envelope Coating: 100 g/L.
  3. Concrete Curing Compounds: 100 g/L.
  4. Concrete Surface Retarder: 50 g/L.
  5. Default: 50 g/L.
  6. Driveway Sealer: 50 g/L.
  7. Dry-Fog Coatings: 50 g/L.
  8. Faux Finishing Coatings:
    - a. Clear Topcoat: 100 g/L.
    - b. Decorative Coatings: 350 g/L.
    - c. Glazes: 350 g/L.
    - d. Japan: 350 g/L.

- e. Trowel Applied Coatings: 50 g/L.
- 9. Fireproofing Coatings: 150 g/L.
- 10. Flat Paints and Coatings: 50 g/L.
- 11. Floor Coatings: 50 g/L.
- 12. Form Release Compound: 100 g/L.
- 13. Graphic Arts (Sign) Coatings: 200 g/L.
- 14. Industrial Maintenance (IM) Coatings:
  - a. Color Indicating Safety Coatings: 480 g/L.
  - b. High Temperature IM Coatings: 420 g/L.
  - c. Non-Sacrificial Anti-Graffiti Coatings: 100 g/L.
  - d. Zinc-Rich IM Primers: 100 g/L.
- 15. Magnesite Cement Coatings: 450 g/L.
- 16. Mastic Coatings: 100 g/L.
- 17. Metallic Pigmented Coatings: 150 g/L.
- 18. Multi-Color Coatings: 250 g/L.
- 19. Non-Flat Paints and Coatings: 50 g/L.
- 20. Pre-Treatment Wash Primers: 420 g/L.
- 21. Primers, Sealers, and Undercoaters: 100 g/L.
- 22. Reactive Penetrating Sealers: 350 g/L.
- 23. Recycled Coatings: 250 g/L.
- 24. Roof Coatings, Non-Aluminum: 50 g/L.
- 25. Roof Coatings, Aluminum: 100 g/L.
- 26. Roof Primers, Bituminous: 350 g/L.
- 27. Rust Preventative Coatings: 100 g/L.
- 28. Sacrificial Anti-Graffiti Coatings: 50 g/L.
- 29. Shellac:
  - a. Clear: 730 g/L.
  - b. Pigmented: 550 g/L.
- 30. Specialty Primers: 100 g/L.
- 31. Stains, Exterior: 100 g/L.
- 32. Stains, Interior: 250 g/L.
- 33. Stone Consolidants: 450 g/L.
- 34. Swimming Pool Coatings:
  - a. Repair: 340 g/L.
  - b. Other: 340 g/L.
- 35. Tile and Stone Sealers: 100 g/L.
- 36. Traffic Coatings: 100 g/L.
- 37. Tub and Tile Refinishing Coatings: 420 g/L.
- 38. Waterproofing Sealers: 100 g/L.
- 39. Waterproofing Concrete/Masonry Sealers: 100 g/L.
- 40. Wood Coatings:
  - a. Varnish: 275 g/L.
  - b. Sanding Sealers: 275 g/L.
  - c. Lacquer: 275 g/L.
- 41. Wood Conditioners: 100 g/L.
- 42. Wood Preservatives:
  - a. Below-Ground: 350 g/L.
  - b. Other: 350 g/L.
- 43. Low-Solids Coating: 120 g/L.
- 44. Colorants:
  - a. Added to Architectural Coatings, Excluding IM Coatings: 50 g/L.
  - b. Added to Solvent-Based IM: 600 g/L.
  - c. Added to Waterborne IM: 50 g/L.

## 2.06 FLOORING SYSTEMS

- A. Flooring materials shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 16.5 micrograms/cu. m or 13.5 ppb, whichever is less. Where postmanufactured coatings or applications have not been applied, concrete; ceramic and concrete tile; clay and concrete pavers; metal; and organic-free, mineral-based flooring shall be deemed to comply with this requirement.

## 2.07 WALL SYSTEMS

- A. Wall systems shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 16.5 micrograms/cu. m or 13.5 ppb, whichever is less. Where postmanufactured coatings or applications have not been applied, concrete, concrete masonry, clay masonry, gypsum plaster, ceramic and concrete tile, metal, and organic-free, mineral-based materials shall be deemed to comply with this requirement.

## 2.08 INSULATION

- A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 16.5 micrograms/cu. m or 13.5 ppb, whichever is less, except for insulation manufactured without formaldehyde.

## 2.09 COMPOSITE WOOD AND AGRIFIBER PRODUCTS

- A. Do not use composite wood and agrifiber products that contain urea-formaldehyde resin.
- B. Engineered Wood Products:
  - 1. Determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
  - 2. Determine Volatile Organic Compounds {VOC}, excluding formaldehyde, emitted from manufactured wood-based panels in accordance with ASTM D6330.
- C. Composite Panel Products:
  - 1. Determine formaldehyde concentrations in air from wood-based panel products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
  - 2. Determine Volatile Organic Compounds {VOC}, excluding formaldehyde, emitted from manufactured wood-based panels in accordance with ASTM D6330.
  - 3. Particleboard Manufacturer's, MDF Manufacturer's, and Melamine Laminator's Facility: CPA EPP (Environmentally Preferable Product) Downstream Licensed Facility.

## **PART 3 EXECUTION - Not Used**

END OF SECTION



**SECTION 01 64 00  
OWNER-FURNISHED PRODUCTS**

**PART 1 GENERAL**

1.01 SUMMARY

- A Section Includes:
  - 1. Owner-furnished products for installation by Contractor (O.F.C.I.).
- B Related Requirements:
  - 1. Owner-Furnished, Owner-Installed (O.F.O.I.) Products: Section 01 10 00 Summary.
  - 2. Common Product Requirements, Transportation, Storage and Handling of Products: Section 01 60 00 Product Requirements.
  - 3. Examination and Acceptance of Substrates and In-Place Construction to Receive Product Installation: Section 01 71 16 Acceptance of Conditions.
  - 4. General Product Installation Requirements: Section 01 73 19 Installation.

1.02 TRANSPORTATION AND HANDLING

- A General: Comply with Section 01 60 00.
- B Handling: Provide equipment and personnel to handle products by methods to prevent soiling or damage. Comply with manufacturer's written instructions.
- C Material Safety Data Sheets (MSDS): During product transportation and handling, comply with controls specified on MSDS for each product required by OSHA to have a MSDS.
- D Delivery: Coordinate delivery schedules with Owner.
- E Inspection: Inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
  - 1. Immediately inform Owner of damaged and defective items, if any.

1.03 STORAGE AND PROTECTION

- A General: Comply with Section 01 60 00.

**PART 2 PRODUCTS**

2.01 OWNER-FURNISHED PRODUCTS

- A Products Furnished by Owner and Installed by Owner or Owner's Separate Vendor or Contractor: Items listed in Equipment Schedule on Drawings and identified as "O.F.O.I." See also Section 01 10 00.
- B Products Supplied by Owner for Installation by Contractor Under This Contract: Items listed in Equipment Schedule or elsewhere on Drawings and identified as "O.F.C.I."

**PART 3 EXECUTION**

3.01 INSTALLATION

- A Comply with Section 01 73 19 and applicable Sections in Divisions 03 through 31.

**END OF SECTION**

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**SECTION 01 71 16**  
**ACCEPTANCE OF CONDITIONS**

**PART 1 GENERAL**

1.01 SUMMARY

A Section Includes:

1. Procedures and general requirements for examination of existing conditions and verification of acceptable conditions for installation.

B Related Requirements:

1. Common Product Requirements: Section 01 60 00 Product Requirements.
2. General Product Installation Requirements: Section 01 73 19 Installation.
3. Cutting and Patching: Section 01 73 29.

1.02 QUALITY ASSURANCE

A Manufacturer's Instructions: Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for verification of existing conditions to extent that these instructions and recommendations are more explicit or more stringent than requirements specified or indicated.

1. Notify Architect of any conflicts between manufacturer's instructions or recommendations and requirements specified or indicated.
2. Coordinate trades constructing substrate and trades installing products to substrate to ensure that surface preparation required by manufacturer's instructions is performed before product installation. Convene pre-installation conference if necessary and discuss issues relating to acceptance of conditions at conference.

**PART 2 PRODUCTS – NOT USED**

**PART 3 EXECUTION**

3.01 EXAMINATION

A Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C Inspection of Substrates: Require installer of each major unit of work to inspect substrate to receive work and conditions under which work is to be performed.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

D Installer: Report unsatisfactory conditions to General Contractor in writing with copy to Architect. Include recommended corrections.

- E Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

**END OF SECTION**

## **SECTION 01 73 19 INSTALLATION**

### **PART 1 GENERAL**

#### 1.01 SUMMARY

- A Section Includes:
  - 1. Common requirements for installing products and materials.
- B Related Requirements:
  - 1. Examination and Acceptance of Substrates and In-Place Construction to Receive Product Installation: Section 01 71 16 Acceptance of Conditions.
  - 2. Common Product Requirements, Transportation, Storage and Handling of Products: Section 01 60 00 Product Requirements.
  - 3. Cutting and Patching: Section 01 73 29.

#### 1.02 REFERENCES

- A Reference Standards: Comply with the following as applicable:
  - 1. United States Department of Justice – 2010 ADA Standards for Accessible Design, September 15, 2010; available at [www.ada.gov/ADAStandards\\_index.htm](http://www.ada.gov/ADAStandards_index.htm).

#### 1.03 QUALITY ASSURANCE

- A Manufacturer's Instructions: Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for installation to extent that these instructions and recommendations are more explicit or more stringent than requirements specified or indicated.
  - 1. Refer to manufacturer's warranty, where applicable, and comply with all installation stipulations necessary to obtain warranty.
  - 2. Compliance with manufacturer's instructions shall include compliance with manufacturer's requirements, if any, for verification of conditions and surface preparation prior to installation, and shall include manufacturer's instructions for protection and cleaning after installation.
  - 3. Notify Architect of any conflicts between manufacturer's instructions or recommendations and requirements specified or indicated.
  - 4. Maintain one copy of each on site from time of product delivery to site until installation and final cleaning of product is complete.

### **PART 2 PRODUCTS**

#### 2.01 MATERIALS

- A Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### **PART 3 EXECUTION**

#### 3.01 INSTALLATION

- A General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
- B Attachment: Provide attachment and connection devices and methods for securing work.
  - 1. Secure work true to line and level, and within specified tolerances, or if not specified, industry recognized tolerances.
  - 2. Allow for expansion and building movement.
  - 3. Exposed Joints:
    - a. Provide uniform joint width.
    - b. Arrange joints to obtain best visual effect.
    - c. Refer questionable visual-effect choices to Architect for final decision.

- C Measurements and Dimensions: Recheck as integral step of starting each installation.
  - D Climatic Conditions and Project Status: Install each unit of work under conditions to ensure best possible results in coordination with entire Project.
    - 1. Isolate each unit of work from incompatible work as necessary to prevent deterioration.
    - 2. Coordinate enclosure of work with required inspections and tests to minimize necessity of uncovering work for those purposes.
  - E Mounting Heights: Where not indicated, mount individual units of work at industry recognized standard mounting heights for particular application indicated.
    - 1. Refer questionable mounting heights choices to Architect for final decision.
    - 2. Comply with ADA Standards as applicable.
  - F Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
  - G Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
- 3.02 PROTECTION
- A Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

**END OF SECTION**

**SECTION 01 73 29  
CUTTING AND PATCHING**

**PART 1 GENERAL**

1.01 SUMMARY

- A Work Results: All cutting, fitting and patching required to complete work and to:
  - 1. Make its parts fit together properly.
  - 2. Uncover portions of work to provide for installation of ill-timed work.
  - 3. Remove and replace defective work.
  - 4. Remove and replace work not conforming to requirements of Contract Documents.
  - 5. Remove samples of installed work as specified for testing.
  - 6. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.
- B Related Requirements:
  - 1. Selective Demolition: Section 02 41 19.

1.02 ADMINISTRATIVE REQUIREMENTS

- A Notification of Architect: Notify Architect well in advance of executing any cutting or alteration that affects:
  - 1. Work of Owner or any separate contractor.
  - 2. Structural value or integrity of any element of Project.
  - 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
  - 4. Efficiency, operational life, maintenance or safety of operational elements.
  - 5. Visual qualities of sight-exposed elements.

**PART 2 PRODUCTS**

2.01 MATERIALS

- A Comply with specifications and standards for each specific product involved.

**PART 3 EXECUTION**

3.01 EXAMINATION

- A Existing Conditions:
  - 1. Examine existing conditions of Project, including elements subject to damage or to movement during cutting and patching.
  - 2. After uncovering work, examine conditions affecting installation of products or performance of work.
- B Notification: Report unsatisfactory or questionable conditions to Architect. Do not proceed with work until Architect has provided further instructions.

3.02 PREPARATION

- A Protection: Provide adequate temporary support as necessary to ensure structural value and integrity of affected portion of work. Provide devices and methods to protect other portions of Project from damage.
  - 1. Provide protection from elements for that portion of Project that may be exposed by cutting and patching work.

3.03 CUTTING AND PATCHING

- A General: Provide openings in construction that are required for later work.
  - 1. Various Contractors: Be responsible to supply in advance, proper and sufficiently detailed information for openings.
  - 2. In event of failure to supply this advance information, required cutting shall be done only after concurrence of Architect and at expense of negligent party.
- B Cutting:
  - 1. Execute cutting and demolition by methods that will prevent damage to other work, and will provide proper surfaces to receive installation or repairs.
  - 2. Employ the original installer or fabricator to perform cutting and patching for:

- a. Weather-exposed or moisture-resistant elements.
- b. Sight-exposed finished surfaces.
3. Employ the original installer or fabricator to perform cutting and patching for:
  - a. Weather-exposed or moisture-resistant elements.
  - b. Sight-exposed finished surfaces.
4. Cut asphalt, concrete or masonry using masonry saw or core drill as applicable.

Pneumatic tools will not be allowed unless accepted by Architect.
- C Fitting: Execute fitting and adjustment of products to provide finished installation to comply with specified products, functions, tolerances and finishes. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- D Patching: Wherever any pipe, conduit, duct, steel member, bracket, equipment, or other material penetrates or passes through fire-resistant wall, ceiling or floor, completely seal voids in construction with cement grout, plaster, or fire-resistant material, embedding sealing material full thickness of wall, ceiling or floor.
- E Finishing: Where surfaces are exposed, finish with same materials specified in finish schedule or material that is on constructed surfaces.
  1. Work: Accomplish with mechanics skilled in finish trade.
  2. Refinish entire surfaces as necessary to provide even finish to match adjacent finishes:
    - a. For continuous surfaces, refinish to nearest intersection.
    - b. For assembly, refinish entire unit.

**END OF SECTION**



## SECTION 01 74 23

### FINAL CLEANING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section includes:
  - 1. Final cleaning prior to delivering Project to Owner.

#### PART 2 PRODUCTS - Not Used

#### PART 3 EXECUTION

##### 3.01 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
  - 1. Comply with safety standards for cleaning.
  - 2. Do not burn waste materials.
  - 3. Do not bury debris or excess materials on Owner's property.
  - 4. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.
  
- B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
  - 1. Remove tools, construction equipment, machinery, and surplus material from Project site.
  - 2. Remove snow and ice to provide safe access to building.
  - 6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - 3. Remove debris and surface dust from limited access spaces, including plenums, shafts, trenches, and similar spaces.
  - 4. Floors: Leave them thoroughly clean when building is turned over to Owner.
    - a. Resilient Floor Coverings: Mop with warm water and mild detergent as recommended by manufacturer of flooring, then thoroughly machine buff.
  - 5. Ceramic Tile: Remove grout haze, observing tile manufacturer's recommendations. Rinse tile work thoroughly with clean water.
  - 6. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - a. Cleaners: Professional window cleaners.
  - 7. Remove labels that are not permanent.
  - 8. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
  - 9. Hardware: Clean and polish hardware and leave clean and free from paint, grease, dirt, etc.

10. Equipment: Carefully and thoroughly clean surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  11. Replace parts subject to unusual operating conditions.
  12. Plumbing: Clean and polish plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure. Clean fittings and exposed plated piping. Leave clean and free from paint, grease, and dirt. Remove labels.
  13. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  14. Clean ducts, blowers, and coils if units were operated without filters during construction.
  15. Electrical: Clean and polish light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures. Clean other electric fixtures, including switchplates, etc. and leave clean and free from paint, grease and dirt.
  16. Leave Project clean and ready for occupancy.
- C. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.
- D. Entire Area of Work, Inside and Out, at Completion: First-class clean condition upon completion before being accepted by Owner.
1. Where extra materials of value remain after completion of Work, they become the Owner's property. Disposition of these materials shall be as directed by Owner.

END OF SECTION

**SECTION 01 77 00  
CLOSEOUT PROCEDURES**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A This Section specifies administrative, and procedural requirements for project closeout, including but not limited to.
  - 1. Inspection procedures.
  - 2. Project record document submittal.
  - 3. Operating and maintenance manual submittal.
  - 4. Submittal of warranties.
  - 5. Final cleaning.
- B Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions 02 through 49.

**1.02 SUBSTANTIAL COMPLETION**

- A Preliminary Procedures: Before requesting inspection for Certification of Substantial Completion, complete the following. List exception in the request.
  - 1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documents for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
    - a. If 100 percent completion cannot be shown, include a list of delayed items, the value of delayed construction, and reasons the Work is not complete.
  - 2. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents, including the Contractor's written warranty of all work (in place) written on firm's letterhead stationary.
- B Obtain and submit release enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases, including, but not limited to:
  - 1. Affidavit of Releases of Liens on AIA Form G706-A:
    - a. From Contractor
    - b. From Sub Contractor(s)
    - c. From Major material Supplier(s)
  - 2. Affidavit of Debts and Claims Payment on AIA Form G-706:
    - a. From Contractor
    - b. From Sub Contractor(s)
  - 3. Submit Contractor's Guarantee Showing:
    - a. One-year warranty from date of Final Acceptance listing all items, which were unable to be completed.
    - b. Certified and current copy of Power of Attorney.
  - 4. Submit record drawings, maintenance manuals, final project photographs, damage or settlement survey, and similar final record information.
  - 5. Deliver tools, spare parts, extra stock, and similar items.
  - 6. Advise the Owner's personnel of changeover in security provisions.
  - 7. Complete start-up testing of systems, and instruction on the Owner's operating and maintenance personnel. Determined or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

**1.03 FINAL ACCEPTANCE**

- A Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following: List exceptions in the request.

1. Submit the final request with release and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
  2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
  3. Submit a certificated copy of the Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Architect.
  4. Submit consent of surety to final payment.
  5. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B Reinspections Procedure: The Architect will reinspect the Work upon receipt of notice that the Work, including inspection list from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Architect.
- C Upon completion of reinspections, the Architect will prepare a certificate of final acceptance, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
- D If necessary, reinspections will be repeated.
- 1.04 RECORD DOCUMENT SUBMITTALS
- A General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access documents for the Architect's reference during normal working hours.
- B Record Drawings: Maintain a clean, undamaged set of blue or black line whiteprints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a crossreference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
  2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or shop Drawings.
  3. Note related change Order numbers where applicable
  4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
- C Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one of other written constructions issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modification. Give particular attention to substitutions, selection of options and similar information on elements that re concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Product Data.
1. Upon Completion of the Work, submit record Specifications to the Architect for the Owner's records.
- D Record Product Data: Maintain one copy of each Product Data submittal. Mark these documents to show significant variations in the actual Work performed in comparison with information submitted. Include variations in products delivered to the site, and from the manufacturer's installation instructions and recommendations. Give particular attention to concealed products and portions of the Work, which cannot otherwise be readily discerned later by direct observation. Note related Change orders and mark-up of record drawings and

specifications.

1. Upon completion of mark-up, submit complete set of record Product Data to the Architect for the Owner's records.
- E Record Sample Submitted: Immediately prior to the date or dates of Substantial Completion, the Contractor will meet at the site with the Architect and the Owner's personnel to determine which of the submitted Samples have been maintained during progress of the Work are to be transmitted to the Owner for record purposes. Comply with delivery to the Owner's Sample storage area.
- F Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filled, ready for continued use and reference. Submit to the Architect for the Owner's records.
- G Maintenance Manuals: Organize operation and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-inch vinylcovered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information.
1. Emergency instructions.
  2. Spare parts list.
  3. Copies of warranties.
  4. Wiring diagrams.
  5. Recommended "turn around" cycles.
  6. Inspection procedures.
  7. Shop Drawings and Product Data.
  8. Fixture lamping schedule.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 CLOSEOUT PROCEDURES**

- A Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representative.

### **3.02 FINAL CLEANING**

- A General: General cleaning during construction is required by the General Conditions and included in Section 01 50 00 - Temporary Facilities And Controls.
- B Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition excepted in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
- C Complete the following cleaning operations before requesting inspection for certification of Substantial Completion.
1. Remove labels that are not permanent labels.
  2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision obscuring materials. Replace chipped or broken glass and other damaged transparent material.
  3. Clean exposed exterior and interior hard-surfaced finishes to dust-free conditions, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition.
  4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures.

5. Clean the site, including landscape development areas, of rubbish, litter and 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.
- D Removal of Protection: Remove temporary protection and facility installed for protection of the Work during construction.
- E Compliance: Comply with regulations of authority having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems.
- F Remove waste materials from the site and dispose of in a lawful manner.
- G Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

**END OF SECTION**

**SECTION 01 78 00**  
**CLOSEOUT SUBMITTALS**

**PART 1 GENERAL**

1.01 PROJECT RECORD DOCUMENTS

- A. Project Site Record Documents: Maintain at Project site one record copy of following:
  - 1. Drawings
  - 2. Specifications
  - 3. Addenda
  - 4. Accepted Shop Drawings, Product Data and Samples
  - 5. Change Orders
  - 6. Other Modifications to Contract
  - 7. Field Test Records
  
- B. Record Documents: Do not use Record Documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.
  
- C. Record Information: Label each document "Record Document".
  - 1. Mark information with contrasting color using ink.
  - 2. Keep each record current. Do not permanently conceal any work until required information is recorded.
  
- D. Drawings: Record following information on drawings:
  - 1. Depth of foundation elements.
  - 2. Horizontal and vertical location of underground utilities.
  - 3. Location of internal utilities and appurtenances concealed in construction.
  - 4. Field changes of dimension and detail.
  - 5. Changes by change order or field order.
  - 6. Details not on original Contract Drawings.
  
- E. Specifications: Record following information on specifications:
  - 1. Manufacturer, trade name, catalog number and supplier of products and items of equipment actually installed.
  - 2. Changes by change order or field order.
  - 3. Other matters not originally specified.
  
- F. Shop Drawings: Maintain shop drawings as Record Documents recording changes made after review as specified for drawings above.
  
- G. Submittal: At completion of Project, deliver Record Documents with transmittal letter containing date, Project title and number, Contractor's name and address, title and number of each Record Document, and certification that each document is complete and accurate. Submittal shall be signed by Contractor. Deliver to Owner's address listed in the Project Directory, unless otherwise directed.
  - 1. Submit both original paper copies as maintained at Project site and electronic files of Record Documents scanned into Portable Document Format (PDF) and/or appropriately annotated to match information on paper copies and saved to compact disk (CD).

## 1.02 FINAL PAPERWORK

- A. Prior to release of final payment, Contractor shall deliver following items to Architect:
  - 1. Inspection Certificates, as applicable.
  - 2. Contractor's Warranty of Materials and Workmanship.
  - 3. Maintenance Manuals and Parts Lists, as specified.
  - 4. All Guaranties, Warranties and Submittals, as specified.
  - 5. Receipts for Extra Materials Delivered to the Owner.
  - 6. Miscellaneous Keys, Switches, Etc.
  - 7. Final Application for Payment.
  - 8. Consent of Surety (if any) to Final Payment.
  - 9. Contractor's Affidavit of Release of Liens (AIA Form G-706A).
  - 10. Project Record Documents
  
- B. The above items are described in following articles or applicable sections of the Specifications.

## 1.03 INSPECTION CERTIFICATES

- A. Each subcontractor shall, upon completion of the work, secure in triplicate, certificates from any state or local governing bodies having jurisdiction in dictating that the work is in strict accordance with the applicable codes and deliver same to the Contractor for transmittal to the Owner.

## 1.04 WARRANTIES

- A. One Year Correction Period: Remedy any defects due to faulty materials or workmanship and pay for any damage to other work resulting therefrom, which shall appear in work within a period of one year from the date of Notice of Substantial Completion and in accordance with the terms of any special warranties provided in the Contract Documents. The Owner shall give notice of observed defects with reasonable promptness.
  
- B. Warranty: Upon completion of work, the Contractor shall deliver to the Architect, in duplicate, a written warranty based on the provisions of the Contract Documents properly signed and notarized.
  - 1. Warranty shall be addressed to the Owner.
  - 2. Provide separate written warranties from mechanical and electrical subcontractors.
  
- C. Subcontractor Warranties: Include labor and materials signed by manufacturer or subcontractor as case may be and countersigned by subcontractor.
  - 1. Address warranty to Owner.
  - 2. Deliver to Architect upon completion of project and before or with submission of request for final payment.
  
- D. Extended Warranties: Deliver in duplicate extended warranties as specified and dated from the date of Notice of Substantial Completion and signed by subcontractors and manufacturers.
  
- E. Manufacturer Warranties: Deliver in duplicate manufacturer's warranties as specified and dated from date of Notice of Substantial Completion signed by manufacturer.
  - 1. Manufacturer's Warranties: Supplement and not replace implied and express warranties provided for by Uniform Commercial Code. Any statements in manufacturer's warranties denying or limiting responsibility for such implied and express warranties shall be void.



## 1.05 MISCELLANEOUS KEYS, SWITCHES AND WRENCHES

- A. At completion of Project, each subcontractor shall account for all loose keys for hose bibs, adjustment keys and wrenches for door closers and panic hardware, keys for electric switches, electrical panels, etc. and turn over to Contractor for transmittal to Owner.

## 1.06 OPERATION AND MAINTENANCE DATA

- A. Operation and Maintenance Manuals: Prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training, submit operation and maintenance manual or manuals to Architect for acceptance.
  - 1. Identify data within each section with identification numbers as they appear on Drawings and by Specification section and article number.
  - 2. Format and Quantity: Submit manual or manuals in each of the following formats and quantities:
    - a. Soft Copy Electronic File: Assemble each manual into a composite electronically indexed Portable Document Format (PDF) file and submit on USB flash drive, compact disk (CD), or other digital media acceptable to Architect.
      - 1) Apply printed identification label to digital media showing Project name and contents.
      - 2) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    - b. Hard Copy Binder: Submit one typed and bound copy of operation and maintenance manual or manuals.
      - 1) Page Size: 8½" x 11".
      - 2) Have index with tab dividers for each major equipment section to facilitate locating information on specific piece of equipment.
- B. Data: Include as minimum following data:
  - 1. Alphabetical list of all system components, with name, address and 24-hour phone number of company responsible for servicing each item during first year of operation.
  - 2. Operating instructions for complete system including:
    - a. Emergency procedures for fire or failure of major equipment.
    - b. Major start, operation and shutdown procedure.
  - 3. Maintenance instructions including:
    - a. Proper lubricants and lubricating instructions for each piece of equipment.
    - b. Necessary cleaning, replacement and adjustment schedule.
  - 4. Manufacturer's product data on each piece of equipment including:
    - a. Installation instructions.
    - b. Drawings and specifications.
    - c. Parts lists.
    - d. Complete wiring diagrams (as-built).
    - e. Marked or changed prints locating all concealed parts and all variation from original system design.
  - 5. Schematic diagram showing component parts of system.
  - 6. Simplified system description and preventative maintenance program.
- C. Operation and Maintenance Data: See Divisions 02 through 49 for equipment requiring operating and maintenance data manuals:

## **PART 2 PRODUCTS – Not Used**

**PART 3 EXECUTION – Not Used**

END OF SECTION

**SECTION 01 78 39  
WARRANTIES**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A This Section specifies administrative, and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard by the Contractor's Documents and special warranties.
- B General closeout requirements are included in Section 01 77 00 - Closeout Procedures.
- C Specific requirements for warranties for the Work and products and installation that are specified to be warranted, are included in the individual Sections of Divisions 02 through 49.
- 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 preprinted 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 require by or incorporate in the Contract Documents, either to extend time limit provide by standard warranties or to provide greater rights for the Owner.

**1.03 WARRANTIES REQUIREMENTS**

- A Related Damages and Losses: When correcting warranted Work that this failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- B Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
- E Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- F The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is require on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

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**SECTION 02 41 19**  
**SELECTIVE DEMOLITION**

**PART 1 GENERAL**

1.01 SUMMARY

A Work Results:

1. For each phase of construction, erect dustproof enclosures separating occupied from unoccupied areas before beginning demolition. Include infection control partitions as noted on Drawings. Remove enclosures when work is completed and patch surfaces damaged by work.
2. Remove designated existing building components and equipment as noted in Demolition Keynotes on Drawings.
3. Remove designated ceiling grid and tiles, gypsum ceiling, light fixtures, sprinkler heads, HVAC equipment, access panels, and wall brackets as noted in RCP Demolition Keynotes on Drawings.
4. Provide shoring and bracing as necessary to ensure structural safety during demolition and until erection of new construction.
5. Cap and identify exposed utilities.
6. Legally dispose of debris off site.
7. Clean up and leave work areas prepared for new construction.

B Related Requirements:

1. Construction Phasing and Use of Premises: Section 01 10 00 Summary and Phasing Plan on Drawings.
2. Alteration Project Procedures: Section 01 35 16.
3. Barricades, Warning Lights and Signs: Section 01 50 00 Temporary Facilities and Controls.
4. Cutting and Patching: Section 01 73 29.
5. Removal and Storage of Construction Materials: Section 02 42 00.
6. Selective Roof Removal: Section 07 02 52 - Cutting And Patching Of Single Membrane Roofing.

1.02 REFERENCES

A General Requirements: Refer to Section 01 42 00.

B Definitions: Meaning of the following terms as used in these Specifications.

1. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
2. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and store as specified in Section 02 42 00.
3. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated under Section 02 42 00.
4. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

C Reference Standards: Comply with the following except as otherwise specified in this Project Manual.

1. American National Standards Institute (ANSI) Standards; [www.ansi.org](http://www.ansi.org).
  - a. ANSI/ASSE A10.6-2006 (R2016) - Safety and Health Program Requirements for Demolition Operations.
2. National Fire Protection Association (NFPA); [www.nfpa.org](http://www.nfpa.org).
  - a. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations, 2013 edition.

### 1.03 ADMINISTRATIVE REQUIREMENTS

#### A Existing Utility Services:

1. Capping: Arrange and pay for disconnecting, removing and capping utility services within areas of demolition. Disconnect and stub off. Notify affected utility company in advance and obtain approval before starting this work.
2. Identification: Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

#### B Materials Ownership:

1. Materials to be Removed by Owner: Items which are removed prior to start of demolition shall remain property of Owner. All other items indicated to be removed but not indicated for reinstallation shall become property of Contractor who shall remove them from site.
  - a. Items to be Removed By Owner: Will be designated with marking prior to pre-bid tour of site.
2. Unless otherwise indicated, demolition waste becomes property of Contractor.
3. Materials called out as salvaged or to be recycled are to be returned to the Owner and are retained as the property of the Owner. See Section 02 42 00.

#### C Coordination with Occupants: Portions of the building will be occupied during construction. See Section 01 10 00 Summary and Section 01 35 16. Do not interfere with use of occupied portions of building. Maintain free and safe passage to and from occupied areas.

#### D Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

### 1.04 INFORMATIONAL SUBMITTALS

#### A Proposed Protection Measures: Submit report for review and approval, including drawings, that indicates the measures proposed for protecting individuals and property, for dust control, and for weather enclosure of the existing building to remain. Indicate proposed locations and construction of enclosures and barriers.

#### B Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

#### C Predemolition Photographs or Video: Submit before Work begins.

### 1.05 SITE CONDITIONS

#### A Existing Conditions:

1. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
2. Asbestos-Containing Materials: This Project is not known to have asbestos-containing materials in area designated for construction.

## **PRODUCTS**

### **2.01 MATERIALS**

A Materials to be Reused: Section 02 42 00.

### **2.02 MATERIALS FOR TEMPORARY INFECTION CONTROL PARTITIONS**

A Fire Resistive Corrugated Board:

1. Basis of Design Manufacturer and Product:
  - a. Manufacturer: Coroplast LLC; www.coroplast.com.
  - b. Product: Firewall FRB.
2. UL94 Class: 94V-2.
3. Material: Polypropylene copolymer.

B Tacky Mat: First Step as manufactured by Advanced Laminated Material Applications, Inc. Provide at all dust partitions and as indicated.

## **EXECUTION**

### **3.01 PREPARATION**

A Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

E Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Dust Protection: Erect and maintain dustproof partitions as required to prevent spread of dust, fumes and smoke to other parts of building. Erect and maintain infection control partitions from floor to underside of ceiling with zipper opening as indicated on Drawings.
5. On completion, remove partitions and repair damaged surfaces to match adjacent surfaces.
6. Cover and protect furniture, furnishings, and equipment that have not been removed.

F Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

G Exterior Openings: Erect secure and weatherproof closures for exterior openings where work includes temporary penetration of exterior assemblies.

### **3.02 SELECTIVE DEMOLITION OF BUILDING ASSEMBLIES AND COMPONENTS**

A Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

B General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Demolish in orderly and careful manner as required to

accommodate new work. Protect existing foundations and supporting structural members.

1. Execute demolition in manner to limit unnecessary dust and noise. Burning of materials on site not allowed.
2. Hazardous Materials: If the Contractor suspects that existing hazardous materials have been uncovered during demolition, do not disturb; immediately stop work in the area and notify the Owner. Hazardous materials will be removed by Owner under a separate contract.
3. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
4. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
5. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

C Protection:

1. Provide necessary temporary shoring and bracing to support and protect portions of existing building during demolition operations. Leave such shoring in place until permanent supports have been installed. Be solely responsible for design, safety and adequacy of temporary shoring and bracing and its ability to carry load for which intended.
2. Protect existing slab to remain. Perform demolition using methods that leave slab surface in optimal condition to receive new construction.

D Safety: Cease operations and notify Architect immediately if safety of structure appears to be endangered. Take precautions to properly support structure. Do not resume until safety is restored.

E Repair: Repair demolition performed in excess of that required at no cost to Owner.

3.03 EXISTING FLOOR COVERINGS

- A Remove existing floor coverings where indicated or new floor coverings are scheduled. Remove existing mastic and leave floors smooth and clean and ready for new floor coverings.

3.04 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.



### 3.05 CLEANING

- A During demolition operations, keep premises free from accumulations of waste material or rubbish caused by employees or work, and at completion of work remove rubbish, tools and surplus material and leave premises clean and ready for subsequent work.

### 3.06 WASTE MANAGEMENT

- A General: Comply with Section 01 50 00 - Temporary Facilities And Controls.
- B Promptly remove waste, rubbish or debris from site.
- C Disposal of Demolished Materials: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site.
  - 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.

**END OF SECTION**

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**SECTION 02 42 00**  
**REMOVAL AND SALVAGE OF CONSTRUCTION MATERIALS**

**PART 1 GENERAL**

1.01 SUMMARY

A Work Results:

1. Remove and salvage designated building equipment and fixtures indicated to be salvaged and delivered to Owner.
2. Remove and salvage designated building equipment, doors, cabinets and fixtures indicated to be relocated in new construction.
3. Store and protect items noted to be saved or relocated.

B Related Requirements:

1. Keynotes on Drawings.
2. Alteration Project Procedures: Section 01 35 16.
3. Selective Demolition: Section 02 41 19.

1.02 ADMINISTRATIVE REQUIREMENTS

- A Building Occupancy: Carry out removal work to cause as little inconvenience to occupants as possible.

1.03 DELIVERY, STORAGE, AND HANDLING

- A Salvaged materials shall be handled with care and deposited in identified storage areas in an undamaged condition.

- B Maintain salvaged materials, clean and store and preserve materials in existing condition until reuse, delivery to or collection by Owner, or removal from site by Contractor.

**PART 2 PRODUCTS**

2.01 EXISTING PRODUCTS

- A Materials and Products Removed by Owner: Items that are removed prior to start of demolition shall remain property of Owner.

- B Products to be Salvaged and Delivered to Owner: See Demolition Notes on Drawings. Items include, but are not necessarily limited to:

1. Equipment to be removed but not to be relocated in the Work.
2. Wall mounted board.
3. Offer all salvageable materials to Owner.

- C Products and Materials to be Reused: All existing doors, frames, hardware, equipment and fixtures scheduled or noted to be reused in other portions of work shall be salvaged and stored on site for later reinstallation. Such products include, but are not necessarily limited to, the following:

1. Equipment as indicated.
2. Door operator and push plate.
3. Sprinkler heads as indicated.
4. Paging speakers.
5. Door and frame as scheduled on Drawings.
6. HVAC grilles.
7. Acoustical ceiling grid.

**PART 3 EXECUTION**

3.01 EXAMINATION

- A Documentation of the original condition of materials to be salvaged for the Owner or for reinstallation shall be the responsibility of the Contractor. Undocumented damage shall become the responsibility of the Contractor and the Contractor shall make necessary repairs to these items before delivery to the Owner or reinstallation in the Project.

### 3.02 REMOVAL OF EQUIPMENT, BUILDING MATERIALS AND COMPONENTS

- A General: Perform removal in orderly and careful manner as required to accommodate new work. Protect existing supporting structural members.
  - 1. Asbestos Containing Materials: If the Contractor suspects that existing asbestos containing materials have been uncovered during removal, immediately stop work in the area and notify the Owner.
- B Materials to be Reused: Carefully remove materials, specialty items, equipment, etc. scheduled or noted to be reused in other portions of work and store at site for later reinstallation.

### 3.03 REPAIR

- A Repair removal performed in excess of that required at no cost to Owner.
- B Repair any damage caused during removal, storage or reinstallation to satisfaction of Architect.

### 3.04 CLEANING AND WASTE MANAGEMENT

- A During removal operations, keep premises free from accumulations of waste material or rubbish caused by employees or work, and at completion of work remove rubbish, tools and surplus material and leave premises clean and ready for subsequent work. Promptly remove waste, rubbish or debris from site.

**END OF SECTION**

**SECTION 03 01 00  
MAINTENANCE OF CONCRETE**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A Cleaning of existing concrete surfaces.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete 2013.

1.04 SUBMITTALS

- A See Section 01 33 00 - Submittal Procedures, for submittal procedures.

1.05 DELIVERY, STORAGE, AND HANDLING

- A Comply with manufacturers' instructions for storage, shelf life limitations, and handling of products.

**PART 2 PRODUCTS**

2.01 CLEANING MATERIALS

- A Detergent: Non-ionic detergent.

2.02 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

- A Bonding Slurry: Water-based latex admixture complying with ASTM C1059/C1059M, combined with Portland cement and sand in accordance with admixture manufacturer's instructions.
- B Cementitious Resurfacing Mortar: One- or two-component, factory-mixed, polymer-modified cementitious mortar designed for continuous thin-coat application.
- C Cementitious Repair Mortar, Trowel Grade: One- or two-component, factory-mixed, polymer-modified cementitious mortar.

**PART 3 EXECUTION**

3.01 EXAMINATION

- A Verify that surfaces are ready to receive work.
- B Beginning of installation means acceptance of substrate.

3.02 CLEANING EXISTING CONCRETE

- A Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
  - 1. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage.
  - 2. Clean out cracks and voids using same methods.
- B The following are acceptable cleaning methods, in order from gentlest to less gentle:
  - 1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, brushes with natural or synthetic bristles.
  - 2. Increasing the water washing pressure to maximum of 400 psi.
  - 3. Adding detergent to washing water; with final water rinse to remove residual detergent.
  - 4. Steam-generated low-pressure hot-water washing.

3.03 FIELD QUALITY CONTROL

- A An independent testing agency, as specified in 01 45 20 - Quality Control Services, will perform field inspection and testing.

**END OF SECTION**

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**SECTION 03 05 16**  
**UNDERSLAB VAPOR BARRIER**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS

- A Section 03 30 00 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS

- A ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.
- B ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2017.

**PART 2 PRODUCTS**

2.01 MATERIALS

- A Underslab Vapor Barrier:
  - 1. Water Vapor Permeance: Not more than 0.010 perms ( 0.6 ng/(s m<sup>2</sup> Pa) ), maximum.
  - 2. Thickness: 15 mils ( 0.4 mm ).
  - 3. Basis of Design:
    - a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil):  
[www.stegoindustries.com/#sle](http://www.stegoindustries.com/#sle).
- B Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

**PART 3 EXECUTION**

3.01 INSTALLATION

- A Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B Lap joints minimum 6 inches ( 150 mm ).
- C Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- D No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- E Repair damaged vapor retarder before covering with other materials.

**END OF SECTION**

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**SECTION 03 20 00  
CONCRETE REINFORCING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A Reinforcing steel for cast-in-place concrete.
- B Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

- A Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A ACI 301 - Specifications for Structural Concrete 2016.
- B ACI 318 - Building Code Requirements for Structural Concrete and Commentary 2014 (Errata 2018).
- C ACI SP-66 - ACI Detailing Manual 2004.
- D ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
- E ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement 2019, with Editorial Revision.
- F ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement 2016.
- G ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement 2016.
- H CRSI (DA4) - Manual of Standard Practice 2009.

1.04 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
  - 1. Prepare shop drawings under seal of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.
- C Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
- D Reports: Submit certified copies of mill test report of reinforcement materials analysis.

1.05 QUALITY ASSURANCE

- A Perform work of this section in accordance with ACI 301.
  - 1. Maintain one copy of each document on project site.
- B Provide Architect with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.
- C Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.

**PART 2 PRODUCTS**

2.01 REINFORCEMENT

- A Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) ( 420 MPa ).
- B Reinforcing Steel: ASTM A706/A706M, deformed low-alloy steel bars.
- C Reinforcing Steel: Deformed bars, ASTM A996/A996M Grade 40 (280), Type A.
- D Reinforcing Steel Mat: ASTM A704/A704M, using ASTM A615/A615M, Grade 40 (40,000 psi) ( 280 MPa ) steel bars or rods, unfinished.
- E Reinforcement Accessories:

2.02 RE-BAR SPLICING:

2.03 FABRICATION

- A Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

### **PART 3 EXECUTION**

#### **3.01 PLACEMENT**

- A Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B Do not displace or damage vapor barrier.
- C Accommodate placement of formed openings.

#### **3.02 FIELD QUALITY CONTROL**

- A An independent testing agency, as specified in Section 01 40 00 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

**END OF SECTION**

## SECTION 03 30 00

### CAST-IN-PLACE CONCRETE

#### 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 cast-in-place concrete, including formwork, reinforcement, concrete materials, warrant adjustments.

- 1. Indicate amounts of mixing water to be withheld for later addition at Project site.

- B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

- C. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

- 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

- 1. Location of construction joints is subject to approval of the Architect.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Welding certificates.

- C. Material Certificates: For each of the following, signed by manufacturers:

- 1. Cementitious materials.

- 2. Form materials and form-release agents.

- 3. Steel reinforcement and accessories.

- 4. Bonding agents.

5. Adhesives.
6. Vapor retarders.
7. Joint-filler strips.
8. Repair materials.

D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

#### 1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## **PART 2 - PRODUCTS**

### **2.1 FORM-FACING MATERIALS**

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

### **2.2 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60, ASTM A 706/A 706M, deformed bars, ASTM A 767/A 767M, zinc coated after fabrication and bending.
- D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, ASTM A 706/A 706M deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.
- E. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, ASTM A 706/A 706M, deformed bars, assembled with clips.
- F. Plain-Steel Wire: ASTM A 82/A 82M.
- G. Deformed-Steel Wire: ASTM A 496/A 496M.
- H. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A, Type 1 coated, - plain steel wire, with less than 2 percent damaged coating in each 12-inch wire length.
- I. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- J. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- K. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.
- L. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, plain steel.

## 2.3 REINFORCEMENT ACCESSORIES

- A. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  1. For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
  2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
  3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

## 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type II.
    - a. Fly Ash: ASTM C 618, Class F.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
  - 2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag Type IP, portland-pozzolan Type I (PM), pozzolan-modified portland Type I (SM), slag-modified portland cement.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.
  - 1. Maximum Coarse-Aggregate Size: see structural drawings.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M.

## 2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
- E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
  - 1. Color: Match Architect's sample, As selected by Architect from manufacturer's full range.

## 2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

## 2.7 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

## 2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.



## 2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  - 1. Types I and II, non-load bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials:
  - 1. Fly Ash: 25 percent.
  - 2. Combined Fly Ash and Pozzolan: 25 percent.
  - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
  - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
  - 5. Silica Fume: 10 percent.
  - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
  - 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
  2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
  4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

#### 2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture per structural general notes.
- B. Slabs-on-Grade: Proportion normal-weight concrete mixture per structural general notes.
- C. Suspended Slabs: Proportion normal-weight concrete mixture per structural general notes.

#### 2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

#### 2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
  1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
  1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
  3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## **PART 3 - EXECUTION**

### **3.1 FORMWORK**

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
  - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  - 3. Install dovetail anchor slots in concrete structures as indicated.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.5 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.
- C. Granular Course: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
  - 1. Place and compact a 1/2-inch- thick layer of fine-graded granular material over granular fill.

### 3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

### 3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls [as indicated] <Insert spacing>. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least [one-fourth] <Insert depth> of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 07 92 00 "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.8 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
  1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly to drains where required.
  5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.



### 3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
  - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
  - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one-part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
  - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one-part portland cement and one-part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
    - b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
    - c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
    - d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.
  2. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate aluminum granule finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.

2. After broadcasting and tamping, apply float finish.
  3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate aluminum granules.
- H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
  2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
  3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

### 3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

### 3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.14 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
  1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Do not apply to concrete that is less than seven days' old.
  3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
  1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
  2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
  3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
  4. Control and dispose of waste products produced by grinding and polishing operations.
  5. Neutralize and clean polished floor surfaces.
- C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

### 3.15 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
  1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### 3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one-part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  - 2. After concrete has cured at least 14 days, correct high areas by grinding.
  - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.17 FIELD QUALITY CONTROL
- A. Testing and Inspecting: Owner will engage a special inspector qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.
  2. Steel reinforcement welding.
  3. Headed bolts and studs.
  4. Verification of use of required design mixture.
  5. Concrete placement, including conveying and depositing.
  6. Curing procedures and maintenance of curing temperature.

7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  2. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

### 3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

**END OF SECTION**



**SECTION 03 35 11  
CONCRETE FLOOR FINISHES**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A Surface treatments for concrete floors and slabs.

1.02 RELATED REQUIREMENTS

- A Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

**PART 2 PRODUCTS**

**PART 3 EXECUTION**

3.01 EXAMINATION

- A Verify that floor surfaces are acceptable to receive the work of this section.
- B Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

- A Apply materials in accordance with manufacturer's instructions.

**END OF SECTION**

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**SECTION 03 62 00  
NON-SHRINK GROUTING**

**PART 1 GENERAL**

1.01 SUMMARY

A Section Includes:

1. Shrink-resistant, cementitious, non-metallic grout for patching and infilling abandoned anchor holes in concrete floor slabs
2. Shrink-resistant, cementitious, non-metallic grout elsewhere as indicated or as required to complete the Work.

1.02 REFERENCES

A General Requirements: Refer to Section 01 42 00.

B Reference Standards: Comply with the following except as otherwise specified in this Project Manual.

1. ASTM International Standards:

- a. ASTM C1107/C1107M-14a – Packaged Dry, Hydraulic-Cement Grout (Non-Shrink).

1.03 ACTION SUBMITTALS

A Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.

B Product Data: Submit manufacturer's product data sheets for each grout product to be installed under this Section.

1.04 DELIVERY, STORAGE, AND HANDLING

A General Requirements: Comply with Section 01 60 00.

B Delivery and Acceptance Requirements: Deliver palletized in original sound, dry, unopened containers with manufacturer's source code marking.

C Storage and Handling Requirements:

1. Store under cover in dry area.
2. Storage Temperature: Minimum 40 degrees F, maximum 90 degrees F unless recommended otherwise by manufacturer.
3. Storage Damage: Immediately remove from site any material which becomes damp or otherwise defective during storage.
4. Storage Time: 6 months maximum, or shorter time if so recommended by manufacturer.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS AND PRODUCTS

A Acceptable Manufacturers and Products:

1. BASF – MasterFlow 928, MasterFlow 713 or MasterFlow 100.
2. Dayton Superior Corporation – 1107 Advantage Grout.
3. Euclid Chemical Company – Euclid NS Grout.
4. L&M Construction Chemicals; www.lmcc.com; brand of Laticrete International, Inc. – Duragrout.
5. Sika Corporation - SikaGrout 212.
6. US Mix Co.; US Spec division; www.usspec.com - US Spec MP Grout or Premium Grout.

B Substitution Requests: Required for all manufacturers and products not named as Acceptable.

1. Submit in accordance with Section 01 25 00.

2.02 DESCRIPTION

A Grout Description: Packaged dry, non-gas forming, non-metallic, cementitious, non-shrink grout.

1. Grout shall contain no aluminum powder.

2.03 PERFORMANCE

A Grout Performance Requirements:

1. Meet or exceed all performance requirements of ASTM C1107.

2. Compressive Strength: In addition to compressive strength performance requirements of ASTM C1107, grout shall provide the following minimum strengths when tested in accordance with ASTM C1107 at plastic consistency.
  - a. 3 Day Strength: 4,500 psi minimum.
  - b. 7 Day Strength: 6,000 psi minimum.
  - c. 28 Day Strength: 7,500 psi minimum.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A Architect's Examination: Provide ample notice to the Architect to allow observation of the preparation and placing of grout. Do not begin placement until approval of Architect is obtained.

#### **3.02 PREPARATION**

- A Surface Preparation for Cementitious Grouting:
  1. Clean steel and concrete surfaces of dirt, oil, grease, laitance, loose concrete and other contaminants.
  2. Remove free-standing water from concrete surfaces before grouting.

#### **3.03 PLACEMENT OF CEMENTITIOUS GROUT**

- A General: Mix and install grout in accordance with manufacturer's recommendations.
  1. Mix with minimum water necessary for placement method to be used.
  2. Extend grout with gravel for placements greater than 3 inches in depth.
- B Grouting: Place grout at non-sag, damp pack consistency, completely filling infill space with grout. Manually compact to eliminate air pockets and voids.

#### **3.04 FINISHING**

- A Screeding: Screed and consolidate surfaces. Finish surfaces sparingly forcing coarse aggregate slightly below surface. Finish floor slab patches flush with adjacent concrete surfaces. Dusting of wearing surfaces with dry materials will not be permitted.
- B Troweling:
  1. Floor Slabs Infill: Steel troweled finish in accordance with ACI 301, Paragraph 5.3.4.2.c with two trowelings. Hand-trowel the surface smooth and free of trowel marks. Continue handtroweling until a ringing sound is produced as the floor is troweled.
- C Requirements for Slab Finish: Comply with requirements of other Sections for slab tolerances, finishes, curing, etc. Be responsible to repair or replace slabs as required and specified in these Sections to meet requirements.

#### **3.05 CURING**

- A Curing Cementitious Grout: Comply with manufacturer's instructions.
  1. Maintain grout temperature between 40 degrees F and 90 degrees F for minimum 24 hours following placement.
  2. Cover exposed grout surfaces with clean, wet rags and maintain moisture for minimum 6 hours following placement.

**END OF SECTION**

## SECTION 03 80 00

### CONCRETE CUTTING AND BORING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section Includes:
  - 1. Flat concrete sawing.
- B. Related Requirements:
  - 1. Selective Demolition: Section 02 41 19..

##### 1.02 REFERENCES

- A. General Requirements: Refer to Section 01 42 00.
- B. Reference Standards: Comply with following reference standards as applicable to the Work indicated.
  - 1. Concrete Sawing and Drilling Association (CSDA) Standards; [www.csda.org](http://www.csda.org).
    - a. CSDA-BB-110 – Bolt Together Core Bits.
    - b. CSDA-BC-107 – Blade Application Code for Diamond Saw Blades.
  - 2. International Association of Concrete Drillers and Sawers; (IACDS); [www.iacds.org](http://www.iacds.org):
    - a. IACDS S-Tolerances-2 2017 - Tolerances and Limits for Concrete Drilling and Sawing.

##### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate with selective demolition work under Division 02 Existing Conditions.
  - 1. Coordinate means of collection and disposal of slurry.
  - 2. Coordinate with demolition work for breaking apart, removal and disposal of concrete sections indicated to be removed after concrete cutting.
  - 3. Shoring and Bracing: Should bracing of the concrete section to be removed be required, ensure it is installed prior to the completion of the sawing operation. If opening to be removed is to stay in place for an extended period, ensure adequate support is provided.
  - 4. Ensure adequate water or slurry control and storage provisions are provided.
  - 5. Ensure adequate ventilation is provided for interior cutting operations.

##### 1.04 EXISTING CONDITIONS

- A. See Document 00 30 00 Available Information for available design drawings.

#### PART 2 PRODUCTS

##### 2.01 SAWING AND DRILLING EQUIPMENT

- A. Comply with applicable CSDA and OSHA standards.
- B. Fastening Saw Blades and Blade Guards: In accordance with Manufacturer's instructions.
- C. Provide supplementary drilling and cutting equipment adequate to accurately cut corners without overcutting.

- D. Core Drills: Include power unit, core drill base, column, carriage and motor assembly properly sized for the hole sizes required. Include mounting equipment, anchors, rotary hammer, vacuum pad, pump and vacuum cleaner.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verification of Conditions: Comply with Section 01 71 16.
- B. Notification: Notify General Contractor of unsatisfactory conditions in writing with copy to Architect.
- C. Acceptance: Beginning of work means acceptance of existing conditions by concrete cutting and drilling contractor.

### **3.02 PREPARATION**

- A. Protection of In-Place Conditions: Protect work to remain in the area of cutting and drilling operations from damage due to these operations, including contamination by slurry and damage from water and concrete debris.
- B. Bracing: Should bracing of the concrete section to be removed be required, install prior to the completion of the sawing operation. If opening to be removed is to stay in place for an extended period, provide adequate support.
  - 1. Wedging: Not acceptable as a bracing technique.
- C. Clearly mark all cut lines prior to the start of cutting operations.
- D. Locate utility lines, if any, contained within or adjacent to the concrete to be cut. Cut off active utilities, if any, at such locations.
- E. When needed, place partitions, barricades or caution tape around work areas to prevent unauthorized personnel from having access to the work area.

### **3.03 FLAT CONCRETE SAWING**

- A. Cut existing concrete slabs utilizing flat saw powered by gas, propane or diesel of the appropriate horsepower and design and blade diameter to accomplish the Project requirements.
  - 1. Fasten blades and blade guards and operate saw in accordance with saw manufacturer's instructions.
- B. Control slurry utilizing vacuuming equipment.
- C. Overcuts: Not allowed.
  - 1. Accurately cut corners using core drill, chain saw, hand saw, or other approved equipment.
- D. Tolerances: Per foot of depth.
  - 1. Depth: Plus-or-minus 1/2-inch.
  - 2. Marked Line: Plus-or-minus 1/4-inch.

### 3.04 CORE DRILLING

- A. Cut circular holes no larger than 6 inches in diameter through existing concrete utilizing a core drill with diamond core drill bits with sufficient life to complete the assigned work.
  - 1. Operate core drilling equipment in accordance with drill manufacturer's instructions.
  
- B. Tolerances:
  - 1. Handheld Core Drilling Tolerances:
    - a. Depth: Plus-or-minus 1/4-inch.
    - b. Angle Off Axis: 1/2-inch in 1-foot.
    - c. Marked Line-Crosshairs: Plus-or-minus 1/2-inch.
  - 2. Rig-Mounted Core Drilling Tolerances:
    - a. Depth: Plus-or-minus 1/4-inch per foot.
    - b. Angle Off Axis: 1/2-inch in 1-foot.
    - c. Marked Line-Crosshairs: Plus-or-minus 1/8-inch.
  - 3. Deep Core Drilling Tolerances: Hole depths 36 inches and deeper.
    - a. Angle Off Axis: Plus-or-minus 1-degree.

END OF SECTION





**SECTION 05 05 19**  
**POST-INSTALLED CONCRETE ANCHORS**

**PART 1 GENERAL**

**1.01 SUMMARY**

**A Section Includes:**

1. Methods common to multiple sections for fastening metals, fabrications, manufactured products, hangers, and equipment to in-place concrete, precast concrete, or concrete masonry, including:
  - a. Post-installed mechanical anchors.
  - b. Post-installed adhesive anchors.

**B Related Requirements:**

1. General Notes on Architectural Drawings.
2. Mechanical Expansion Anchors for Pipe Hangers and Plumbing Equipment: Section 22 05 29 Hangers and Supports for Plumbing Piping and Equipment.
3. Mechanical Expansion Anchors for HVAC Pipe Hangers and HVAC Equipment: Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.
4. Mechanical Expansion Anchors for Electrical Items and Supports: Section 26 05 29 Hangers and Supports for Electrical Systems.

**1.02 REFERENCES**

**A Definitions:**

1. Interior Use: For purposes of this Section, "Interior Use" shall mean interior applications in a non-corrosive environment.
2. Exterior Use: For purposes of this Section, "Exterior Use" shall mean applications exposed to weather in service and interior applications in a potentially corrosive environment, including, but not limited to, the interior of parking structures, pool rooms, pool equipment rooms, vehicle service and wash areas, animal holding rooms, shower areas and steam rooms.

**B Reference Standards: See Section 01 42 00.**

1. American Concrete Institute (ACI) Standards:
  - a. ACI 355.2-07 - Qualification of Post-Installed Mechanical Anchors in Concrete.
  - b. ACI 355.4-11 - Qualification of Post-Installed Adhesive Anchors in Concrete.
2. International Code Council Evaluation Service (ICC-ES) Standards:
  - a. AC193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements.
  - b. AC308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

**1.03 ACTION SUBMITTALS**

**A Procedures:** Submit for review, action and return in accordance with Section 01 33 00.

**B Product Data:** Submit manufacturer's technical data for the following.

1. Post-Installed Anchors: Submit for each type proposed for use on Project. Include statement of proposed applications and locations for each type of anchor.

**1.04 INFORMATIONAL SUBMITTALS**

**A Procedures:** Submit for information and verification in accordance with Section 01 33 00.

**B Evaluation Reports:** Submit ICC-ES Evaluation Report for each manufactured anchor product proposed for use on the Project.

**C Test Reports:** Submit certified test reports showing compliance with specified performance characteristics and physical properties.

**D Manufacturer's Instructions:**

1. Submit manufacturer's installation instructions.

**1.05 DELIVERY, STORAGE, AND HANDLING**

**A General Requirements:** Comply with Section 01 60 00 - Product Requirements.

1. Protect metals from corrosion.
- B Storage and Handling Requirements:
  1. Storage: Store manufactured anchors in accordance with manufacturer's recommendations.

## **PART 2 PRODUCTS**

### **2.01 PRODUCT OPTIONS**

- A Basis of Design Anchor Manufacturer and Model: Where anchor manufacturer and model is indicated on Drawings, provide indicated product.
- B Where anchor manufacturer and model is not indicated on Drawings, subject to compliance with other specified requirements, provide one of the products named in this Section for anchor type indicated.
  1. Include anchors required to comply with installation instructions and typical details of product manufacturers and equipment suppliers under all divisions of these Specifications, where anchors are not furnished by supplier of the product or equipment to be anchored.
- C Substitution Requests: Required for all proposed post-installed anchor manufacturers and products not named in this Section or on Drawings.
  1. Submit current ICC-ES report with each proposed anchor substitution request. Report shall include compliance documentation for the proposed:
    - a. Base material to receive anchor;
    - b. Base material condition limitations;
    - c. Applicable loading conditions; and
    - d. Load direction(s).
  2. Submittals: Submit in accordance with Section 01 25 00.

### **2.02 REGULATORY REQUIREMENTS**

- A Manufactured post-installed anchors shall have published ICC-ES Evaluation Report (ICC-ESR) indicating conformance with current applicable ICC-ES Acceptance Criteria and ICC approval as acceptable method of construction under the IBC. Comply with all limitations on use of anchors stipulated in Evaluation Report.
- B Post-Installed Anchors for Supporting Fire Sprinkler Systems: Comply with NFPA 13. Anchors shall be qualified in accordance with UL for use with "Pipe Hanger Equipment and Fire Protection Systems."

### **2.03 POST-INSTALLED ANCHOR MATERIALS, GENERAL**

- A Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) or hot-dip galvanizing in accordance with ASTM A153.

### **2.04 MECHANICAL ANCHORS**

- A Regulatory Requirements:
  1. Mechanical Anchorage to Concrete: Expansion anchors, wedge anchors, sleeve anchors, undercut anchors, and drop-in anchors shall have current ICC-ES report that demonstrates compliance with ACI 355.2 as supplemented by AC193 for use in cracked concrete.
    - a. Structural Anchorages and Safety Related Anchorages in Structures Designed for Seismic Design Category C, D, E, or F: Documentation shall also show that anchor has passed simulated seismic tests in accordance with ACI 355.2.
      - 1) Seismic Design Category: See General Notes on Architectural Drawings.
- B Wedge Anchors for Anchorage to Solid Concrete:
  1. Manufacturers and Products: Where anchor manufacturer and product is not indicated, subject to compliance with requirements, provide the following:
    - a. Hilti Inc.; [www.us.hilti.com](http://www.us.hilti.com) - Kwik Bolt TZ (KB-TZ). Refer to ICC ESR-1917.

2. Description: Wedge type expansion anchor, torque-controlled, complete with required nuts and washers.
  3. Provide anchors with length identification markings conforming to ICC ES AC193.
- C Type and size as indicated on Drawings or by manufacturer of product to be anchored.
- 2.05 CARTRIDGE INJECTION ADHESIVE ANCHORS**
- A Regulatory Requirements.
1. Adhesive Anchorage to Concrete: Adhesive anchors shall have current ICC-ES report that demonstrates compliance with ACI 355.4 as supplemented by AC308 for use in cracked concrete.
    - a. Structural Anchorages and Safety Related Anchorages in Structures Designed for Seismic Design Category C, D, E, or F: Documentation shall also show that anchor has passed simulated seismic tests in accordance with ACI 355.4.
      - 1) Seismic Design Category: See General Notes on Architectural Drawings.
- B Manufacturers and Products – Anchorage to Concrete: Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Architect, provide one of the following:
1. Hilti Inc.; [www.us.hilti.com](http://www.us.hilti.com) – HIT RE 500-SD Adhesive Anchoring System with twocomponent epoxy with threaded rod anchors. Refer to ICC ESR-2322.
  2. ITW Red Head division of Illinois Tool Works; [www.itwredhead.com](http://www.itwredhead.com) – Epcon G5 Adhesive Anchoring System with two-component epoxy and threaded rod anchors. Refer to ICC ESR1137.
  3. Powers Fasteners; [www.powers.com](http://www.powers.com) - PE1000+ Epoxy Adhesive Anchoring System with two-component epoxy and threaded rod anchors. Refer to ICC ESR-2583.
  4. Simpson Strong Tie Co.; [www.strongtie.com](http://www.strongtie.com) – Set-XP Epoxy Adhesive Anchors with twocomponent epoxy and threaded rod anchors. Refer to ICC ESR-2508.
- C Steel Anchors: Threaded steel rod or inserts, complete with nuts, washers, adhesive injection system. Type and size as indicated on Drawings.
1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) or carbon steel rods conforming to ASTM A510 with chemical composition of AISI 1038.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A General: Install post-installed anchors and inserts in accordance with applicable ICC-ES Report and with manufacturer's instructions in accurately drilled holes of required diameter and depth.
1. Avoid installing anchors in contact with galvanically dissimilar metals.
- B Drilling:
1. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, and grout has achieved full design strength.
  2. Drill holes with rotary impact hammer drills using carbide-tipped bits and core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
    - a. Cored Holes: Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer.
    - b. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Architect and Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and

telecommunications conduit, and gas lines.

- C Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10 percent of the specified torque, 100 percent of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Architect and Structural Engineer.
- D Cartridge Injection Adhesive Anchors: Clean all holes in accordance with manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Holes may be dry, damp or wet. Inject adhesive into 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. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
- E Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

### 3.02 ADJUSTING

- A Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

### 3.03 SITE QUALITY CONTROL

- A Special Inspection and Testing, General: See Section 01 45 20. Special Inspection and testing of post-installed anchors will be performed by an independent testing agency engaged by the Owner.
- B Testing of Post-Installed Anchors: Quality control testing shall be performed by independent testing agency. A manufacturer's representative shall be available to consult with the testing agency prior to and during the testing.
  - 1. Testing: Comply with Expansion Anchor Bolt Notes on Architectural Drawings.
- C Special Inspection: See Section 01 45 20.
  - 1. Special inspection is required for all post-installed anchor installations.

**END OF SECTION**

**SECTION 05 12 00  
STRUCTURAL STEEL FRAMING**

**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. Structural steel.
- 2. Grout.

- B. Related Sections:

- 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel fabrications not defined as structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Lateral Force Resisting System: Elements of structural-steel frame designated as "LFRS" or along grid lines designated as "LFRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
  - 1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
  - 2. Welded built-up members with plates thicker than 2 inches.
  - 3. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
  - 1. Select and complete connections using details indicated on Contract Documents and AISC 360.
  - 2. Use LRFD; data are given at factored-load level.
- B. Moment Connections: Type PR, partially or FR, fully restrained.
- C. Construction: Shear wall system.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
  - 1. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
  - 2. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
- C. Calculation Requirements:
  - 1. Submit typical connection calculations as specified.
  - 2. For structural steel connections indicated to comply with design loads, include structural design data and calculations along with Shop Drawings, signed and sealed by the qualified professional engineer responsible for their preparation.
  - 3. For calculations generated by computerized proprietary software, include sufficient design assumptions, input and output information to permit their proper evaluation. Submit a sample problem with manual calculations for each type of connection to illustrate details of computerized calculations, unless waived by the Architect during connection review meeting.
- D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint including the following:
  - 1. Power source (constant current or constant voltage).
  - 2. Electrode manufacturer and trade name, for demand critical welds.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer fabricator.
- B. Welding certificates.
- C. Forged Steel Structural Hardware.
  - 1. Submit copies of test results of breaking strength for forged steel structural hardware.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE, CSE.
- C. Employ a steel erector who has had 5 years of successful experience in erection of structural steel and is able to furnish evidence of erector's ability, facilities, proficiency of erector's personnel and completed projects.
- D. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- F. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC 303.
    - a. Throughout AISC 303, replace "Structural Design Drawings" with "Design Drawings and other Contract Documents".
    - b. Delete paragraph 3.3 – Discrepancies.
    - c. Delete paragraph 4.4 – Approval, and replace with the following:
      - 1) Refer to the Condition of Contract and Section 01330, Submittal Procedures.

- 2) Review of Shop Drawings by the Architect shall not relieve the Contractor of responsibility for accuracy of detail dimensions, fit of parts assembled in shop or field, ability to erect the material, or other Contract requirements.
  - 3) Notation by the Architect made on the Shop Drawings does not authorize changes to the Contract requirements including Contract sum or Contract time.
- d. Paragraph 4.6 – The RFI Process: Omit reference to “Revision to the Contract Document”.
  - e. Delete paragraph 9.3 – Revisions to Contract Documents.
  - f. Paragraph 9.4 – Contract Price Adjustment, replace with the following:
    - 1) Revision to the Contract Documents and Contract Price Adjustment shall be as per the Condition of Contract.
- 2. AISC 341 and AISC 341s1.
  - 3. AISC 360.
  - 4. AWS D1.1 “Structural Welding Code”, with the exception as listed in AISC 360-05 specification section J2, apply in lieu of AWS provisions and to the following:
    - a. Delete section 5.3.3.4, “Recrushed Slag”
  - 5. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.



4. Do not store material on structure that might cause distortion, damage or overload to members or supporting structures. Repair or replace damaged materials or structures as directed by the Architect.

#### 1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

#### 1.10 PROJECT CONDITIONS

- A. Measurements:
  1. Make such field measurements as are necessary to lay out the Work properly.
- B. Alteration and Connections to existing steel:
  1. Make all necessary field measurements for detailing, fabricating and installing reinforcing and new members to be connected to existing steel or reworking existing members. Identify conditions prohibiting installation as indicated.

### **PART 2 - PRODUCTS**

#### 2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
  1. For ASTM A6/A6M hot rolled shape with a flange thickness 50 mm (2 in.), provide steel with minimum Charpy V-notch (CVN) toughness of 27 J (2- ft.-lb.) at 21° C (70°F) tested in the alternate core location as per ASTM A6/A6M, Supplementary Requirements S5 and S30.
  2. For built-up heavy shapes, provide steel plates with CVN as per AISC 360 and AISC 341.
- B. Channels, Angles, S-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50 (345).
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- F. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

- G. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
  - 1. Weight Class: Standard, Extra strong or Double-extra strong.
  - 2. Finish: Galvanized.
- H. Welding Filler Materials, Fluxes and Electrodes: Comply with AWS requirements. Provide filler metal for welds used in members and connections in seismic load resisting system with a minimum Charpy V-notch toughness of 27 J (20 ft-lb) at 0°F (minus 18°C) as determined by appropriate AWS classification.

## 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Carbon Steel Bolts: ASTM A 307.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- C. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.
- D. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
  - 1. Finish: Hot-dip zinc coating, Mechanically deposited zinc coating, Hot-dip or mechanically deposited zinc coating.
  - 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating or mechanically deposited zinc coating, baked epoxy-coated finish.
- E. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
  - 1. Finish: Plain.

- F. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- G. Unheaded Anchor Rods: ASTM F 1554, Grade 36, ASTM F 1554, Grade 55, weldable.
  - 1. Configuration: Straight.
  - 2. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
  - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
  - 4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
  - 5. Finish: Plain.
- H. Headed Anchor Rods: ASTM F 1554, Grade 36, ASTM F 1554, Grade 55, weldable, straight.
  - 1. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
  - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
  - 3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
  - 4. Finish: Plain.
- I. Threaded Rods: ASTM A 36/A 36M.
  - 1. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
  - 2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
  - 3. Finish: Plain.
- J. : Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

### 2.3 PRIMER

- A. Primer: Comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Primer: SSPC-Paint 23, latex primer.

### 2.4 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
  - 1. Camber structural-steel members where indicated.
  - 2. Fabricate beams with rolling camber up.
  - 3. All provisions of AWS D1.1 apply to welds.
  - 4. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
  - 5. Mark and match-mark materials for field assembly.
  - 6. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
  
- B. Shop Welding: Perform welding in accordance with approved welding procedures and AWS D1.1, except as modified in Section J2 of AISC 360-05.
  - 1. Enforce and supervise approved procedure for welding during fabrication of structural steel by employing experienced supervisors knowledgeable of good welding practices.
  - 2. Assemble and weld built-up sections by method that will maintain true alignment of axes without exceeding tolerance of AISC 303-05.
  - 3. Remove backing bars or run off tabs, back gouge, and grind smooth as per AWS D1.1 requirement.
  
- C. High Strength Steel Bolting.
  - 1. Joints subjected to fatigue load with reversal of loading direction.
  - 2. Joints installed in oversized holes.
  - 3. Joints that utilize slotted hole except those with applied load normal to long dimension of the slot.
  - 4. Joints in which slip at the faying surface would be detrimental to the performance of the structure.
  - 5. Joints in which fastener pretension is required in the governing code or specification.
  - 6. Joints subjected to load reversal.
  - 7. Joints subjected to fatigue load with no reversal of loading.

8. Joints with ASTM A325 or F1852 bolts subjected to tensile fatigue. Joints with ASTM (5) A490 bolts that are subjected to tension, or combined shear and tension, with or without fatigue.
  - a. ST joints are permitted for all other application and should be used whenever possible.
  - b. Mixing of A325 and A490 bolts of same diameter should be avoided to assure that bolts are installed in proper locations.
  - c. Do not use A490 bolts larger than one-inch diameter in SC joint as torque required to install these is beyond the commonly available wrenches.
  - d. Coordinate and indicate on drawing joint types.
9. Shop install high-strength bolts according to RCSC™s Specification for Structural Joints Using ASTM A325 or A490 Bolts for type of bolts and type of joint as indicated.
  - a. Snug tightened joints (ST): Bearing type connections based on allowable stresses with threads included in shear plane (Type N). Faying surfaces and surfaces adjacent to bolt heads and nuts shall be free of dirt and other foreign material.
  - b. Pretensioned joints (PT): Provide PT joints as indicated. Use turn-of Nut (nut rotation from snug-tight condition), calibrated wrench pretensioning, Tension-Control (twist-off) bolt assembly conforming to ASTM F1852, or Direct-Tension Indicator conforming to ASTM F959 as pretensioning method Faying surfaces adjacent to bolt heads and nuts shall be free of dirt and other foreign material.
  - c. Slip-Critical Joints (SC): Provide SC joints as indicated using direct tension indicator conforming to ASTM F959 or Tension-Control (twist-off) bolt assembly conforming to ASTM F1852 and installed according to Section 8 of RSSC. Faying surfaces shall be free of burr, blast cleaned to comply with RCSC Class B and coated with a coating in accordance with the requirement of RCSC meeting Class B requirement.

D. Anchor Rods (Bolts).

1. Furnish anchor rods (bolts) as indicated to be embedded in concrete, including nuts and washers. Detail anchor rods (bolts) such that the minimum projection above the nut, after the column is in place, is 25 mm (one inch).

E. Columns and Base Plates.

1. Furnish anchor rods (bolts) as indicated to be embedded in concrete, including nuts and washers. Detail anchor rods (bolts) such that the minimum projection above the nut, after the column is in place, is 25 mm (one inch).

F. Beams.

1. Provide one-piece beams without splice(s), unless otherwise indicated. Where splices are permitted, splice connections shall develop the strength of the beam.
- G. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- H. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- I. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- J. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- K. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
1. Cut, drill, or punch holes perpendicular to steel surfaces.
  2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
- L. Hollow Structural Steel and Other Closed End Members.
1. Provide hollow structural steel and other closed end members with cap plates with watertight welds at the ends and with weep holes where indicated.
- M. Connections for Other Work.
1. Notify other trades so that holes in structural steel can be provided for attachments where required. Provide necessary holes if information is received prior to fabrication.
  2. Make provisions in structural steel for the following:
    - a. Future expansion where shown.
    - b. Connections to existing building where required.
  3. Unless otherwise indicated, holes for attachment of wood blocking: 13 mm (1/2 inch) diameter at 600-mm (24-inch) spacing.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened Pretensioned Slip critical.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Enforce and supervise approved procedure for welding during fabrication of structural steel by employing experienced supervisors knowledgeable of good welding practices.
  2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.
  3. Remove backing bars or run off tabs, back gouge and grind smooth as per AWS D1.1 requirements.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces to be field welded.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 3, "Power Tool Cleaning."
  2. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
  3. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Primer:
1. Slow Dry Penetrating Shop Prime Coat:
    - a. For shop coat and field touch-up:
      - 1) Tenemec 10-1009, gray.
      - 2) Carboline Carbocoat 150 HG 0700, gray.
      - 3) Sherwin Williams B50 AZ8, gray.
  2. Fast-Dry Prime Coat:
    - a. For shop coat and field touch-up:
      - 1) Tenemec 88HS 559, gray.
      - 2) Carboline Carbocoat 115 SG 0700 gray.

3) Sherwin Williams B50AV 8431, gray.

- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
  2. Detail the structural steel with a minimum of 1-inch (25 mm) of anchor rod (bolt) thread projecting above the nuts and the base plate hole 1-1/3 times the rod (bolt) diameter. Based on these procedures, the foundations shall be found acceptable if erection can be accomplished within AISC 303-05 tolerances for plumbness and elevation, and with minimum-maximum grout thickness of 1/2 to 2 inches (13 to 50 mm).
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
- B. Design and provide temporary supports, such as guys, bracing, falsework, cribbing or other elements required for steel framework erection, including partly assembled steel framing in consideration of noted interaction items. Design temporary supports to withstand all loads to which the structure may be subjected during erection and subsequent construction, including erection equipment.
- C. Furnish and place all temporary bracing necessary for erection before bolting or welding. Only light drifting will be permitted to draw parts together. Drifting to match unaligned holes will not be permitted. Perform enlargement of holes necessary to make connections resulting from misfit by drilling and reaming; then use the proper size bolt.

#### **3.3 ERECTION**

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Comply with OSHA 29 CFR 1926, and all [state], city and municipal laws for steel erection.



- C. Foundation and anchor rods (bolts) are designed for the forces of completed structure. Forces due to erection are the responsibility of the Contractor.
- D. Start steel erection only after concrete in the supporting structure such as footings, piers and walls or mortar in masonry piers and walls has attained minimum 75 percent of intended strength or sufficient strength to support the loads imposed during steel erection.
- E. In planning the method of erection, make full allowance for obstructions encountered which may result from work performed by other trades as well as the operations of the Owner.
- F. In planning the method of plumbing the structure, make allowance for temperature difference between time of erection and mean operating temperature of structure when completed. Take into account differential temperature effects on column lengths in plumbing when tall frames are subjected to strong sun exposure on one side.
- G. Furnish and deliver to the job site anchor rods (bolts), and templates for setting the anchor rods (bolts).
  - 1. Lateral-load-resisting system and connecting diaphragm that provides lateral strength and stability in completed structure.
  - 2. Any special erection considerations that are required by design such as shores, jacks or load that must be adjusted during erection, etc.
- H. All lateral load resistance and stability of the completed structure in each orthogonal direction is provided by shear walls and connection diaphragm elements of steel floor deck, fastening and concrete.
- I. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of baseplate.
  - 3. Anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.
- J. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- K. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- L. Splice members only where indicated.
- M. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- N. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- O. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- P. Elastomeric Bearings: Install elastomeric bearing per Division II, Section 18 of AASHTO Standard Specification for Highway Bridges and manufacturer's recommendations.
- Q. Slide Bearings: Install slide bearing per Division II, Section 18 of AASHTO Standard Specification for Highway Bridges and manufacturer's recommendations.
- R. Cables: Avoid damage to cables and their coating during erection. Do not drag over or around any objects that will scrub, abrade or distort the wires, thereby damaging protective coating or cable assemblies.
1. Do not bend or kink cables during erection.
  2. Follow the recommendations of the cable and fitting manufacturers, when permanent fittings are attached to cables in the field.
- S. Rails for Top-Running Crane: Align the crane rail on one side of a craneway with surveyor's instrument. Gauge the opposite rail from the first side at every 3-meter (10-foot) intervals for the full length of the runway, making suitable adjustments at these intervals, including all necessary readjustments when checked for backsight and foresight readings, such that final tolerance from true line and level do not exceed 3 mm (1/8 inch).
- T. Pins [and Rollers]: Install pins [and rollers] per Section 11.4.9 of the AASHTO reference, Division II - Construction. Secure pins in position by hexagonal recessed nuts. [For pins over 250 mm (10 inches) in diameter, hold pin in place by a recessed cap at each end and secure by bolt passing completely through the caps and pin.]

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened Pretensioned Slip critical.

- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  2. Field welding will be permitted only where indicated on approved Shop Drawings or where otherwise approved by the Architect. Perform field welding in accordance with the approved welding procedures and AWS D1.1 except as modified in Section J2 of AISC 360-05.
  3. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
  4. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
  5. Remove backing bars or runoff tabs, back gouge and grind smooth as per AWS D1.1 requirements.

### 3.5 FIELD QUALITY CONTROL

- A. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.
- B. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

### 3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

**END OF SECTION**

**SECTION 05 12 53**  
**MISCELLANEOUS STRUCTURAL STEEL**

**PART 1 GENERAL**

**1.01 SUMMARY**

**A Section Includes:**

1. Structural steel anchorages and support assemblies connecting to existing structure, including, but not necessarily limited to, the following.
  - a. Duct support framing and bracing.
  - b. Counter supports.
  - c. Rooftop unit curb.

**B Related Requirements:**

1. General Notes on Architectural Drawings.
2. Post-Installed Concrete Anchors: Section 05 05 19.
3. Bracing: Section 05 40 00 Cold-Formed Metal Framing.
4. Metal Fabrications: Section 05 50 00.

**1.02 REFERENCES**

**A Reference Standards: See Section 01 42 00. Comply with listed reference standards except as superseded by notes on the Drawings or by these Specifications.**

1. Design, Detailing, Fabrication and Erection: ANSI/AISC 360-16 - Specification for Structural Steel Buildings, June 22, 2010.
2. AISC 303-10 - Code of Standard Practice for Steel Buildings and Bridges, limited to the following:
  - a. Fabrication, Delivery and Erection of Steel: Comply with Sections 5 through 8.
3. American Welding Society (AWS) Standards:
  - a. AWS D1.1/D1.1M:2015 – Structural Welding Code – Steel.
4. Society for Protective Coatings SSPC-PA 1 - Shop, Field and Maintenance Painting of steel.

**1.03 ACTION SUBMITTALS**

**A Procedures: Submit for review, action and return in accordance with Section 01 33 00.**

**B Shop Drawings: Submit shop and erection drawings for all members and assemblies under this Section.**

1. Shop drawings shall be original drawings produced by the subcontractor or supplier and shall not be reproductions of the Contract Documents.
2. Shop drawings shall clearly indicate the following:
  - a. Profiles, sizes, spacing, and locations of structural steel members.
  - b. Connections, attachments, and anchorages.

**1.04 INFORMATIONAL SUBMITTALS**

**A Certificates:**

1. Mill Test Reports:
  - a. Upon request, furnish for all structural steel supplied.
  - b. Furnish mill test reports and load test results of each lot of high strength bolts if requested by Architect.

**1.05 QUALITY ASSURANCE**

**A Qualifications:**

1. Welder Qualifications: Welding shall be performed only by certified welding operators currently qualified in accordance with the testing procedures of AWS D1.1 for the weld types and positions required for the installations indicated.
  - a. If recertification of welders is required, retesting shall be Contractor's responsibility.

**1.06 DELIVERY, STORAGE, AND HANDLING**

**A General Requirements: Comply with Section 01 60 00 - Product Requirements.**

- B Storage and Handling Requirements:
  - 1. Steel: Store members above ground on platforms, skids or other supports and stored upright to prevent twisting. Protect steel from corrosion.

## **PART 2 PRODUCTS**

### **2.01 STRUCTURAL STEEL SHAPES**

- A Channels (C and MC) and Angles (L): ASTM A36.
- B Bars and Plates: ASTM A36.
- C Steel Tubes: ASTM A500, Grade C.

### **2.02 FASTENERS, ANCHORS AND WELDING MATERIALS**

- A Bolts: ASTM A307.
  - 1. Type: Type N with bolt threads included in shear plane.
- B Nuts: ASTM A563.
- C Washers: Provide flat circular washers or square or rectangular beveled washers as indicated or required for each bolted connection.
- D Welding Materials for Steel:
  - 1. Filler Metals for Welding: Meet requirements of AWS D1.1.
    - a. Strength Level: In accordance with AISC and AWS specifications for base metals joined, weld type, and direction of applied load to weld.
  - 2. Welding Electrodes: AWS 5.1 or A 5.5.

### **2.03 FABRICATION**

- A General: Fabricate structural steel in accordance with AISC specifications.
- B Connections: Fabricate structural steel components with shop-welded connections or shopbolted connections as indicated and to provide for field-welded or field-bolted connections as shown or noted on the Drawings.
- C Finished Work: Finish work in accordance with accepted shop drawings.
  - 1. Work: True and free from twists, kinks, buckles, open joints and other defects.
- D Welding: Comply with AISC Specifications and AWS D1.1.
  - 1. Weld sizes not indicated on Drawings shall be ¼-inch continuous fillet but not less than AISC specified minimum based on thickness of parts joined.

### **2.04 SHOP FINISHES**

- A General:
  - 1. Structural Steel Surfaces: Clean and shop coat all fabricated items with shop primer in accordance with SSPC-PA 1.
- B Shop Primer: Comply with OSHA Subpart R. One of the following.
  - 1. Interior: Tnemec Series V10 modified alkyd primer.
  - 2. Society for Protective Coatings Specification SSPC-Paint 25 lead and chromate free primer.
- C Shop Priming:
  - 1. Surface Preparation: After fabrication and shop assembly, clean off all loose rust, loose mill scale and weld spatter, slag or flux deposits in accordance with SSPC procedures as follows:
    - a. Surfaces to be Concealed in the Completed Structure: SSPC-SP 3 Power Tool Cleaning or better.
    - b. Surfaces to be Exposed in the Completed Structure: SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning.
  - 2. Shop Paint Thickness:
    - a. Standard Shop Primer: 2.5 dry film mils.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A Protection: Protect adjacent materials or areas below from damage due to weld splatter or sparks during field welding.
- B Field Measurements: Take measurements on site as required for correct fabrication and installation. Be responsible for errors in fabrication and for correct fit of structural steel.

### **3.02 INSTALLATION**

- A General: Follow applicable provisions of AISC specifications.
- B Install structural steel to lines and elevations indicated within specified erection tolerances.
  - 1. Align and adjust accurately before fastening.
  - 2. Splice only where indicated on Drawings.
  - 3. Field correction of fabricated items by gas cutting not allowed.
- C Field Connections: Make connections between steel members with bolts or field welding as indicated.
  - 1. Clean existing surfaces before welding to existing steel.
  - 2. Tighten bolts to snug tight condition with nut rotation sufficient to bring all plies in joint into firm contact.
  - 3. Drifting or cutting to enlarge unfair holes not allowed.
  - 4. Make minor corrections by reaming.
- D Field Modification: Using cutting torch for field modification or refabrication of structural steel not allowed without written acceptance of Architect. Be responsible for errors in fabrication and for correct fit in field.
- E Allowable Tolerances: Comply with requirements of AISC Code of Standard Practice.
  - 1. Deviation of member working point horizontal location and elevation with respect to the supporting member shall not exceed plus-or-minus 1/16-inch from the location and elevation shown on Drawings.

**END OF SECTION**

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## SECTION 05 40 00

### COLD-FORMED METAL FRAMING

#### 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. Structural metal stud framing, vertical and horizontal.
2. New sister studs to reinforce existing studs as indicated.
3. Metal stud braces.
4. Deflection tracks.
5. Flat strap connections.
6. Soffit framing.
7. Other structural metal stud framing as indicated.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- B. Shop Drawings:
  1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
  1. Steel sheet.
  2. Expansion anchors.
  3. Power-actuated anchors.
  4. Mechanical fasteners.
  5. Vertical deflection clips.
  6. Horizontal drift deflection clips

7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

#### 1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

C. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

### **PART 2 - PRODUCTS**

#### 2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

a. Soffit Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

a. Upward and downward movement of 1/2 inch.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

B. Cold-Formed Steel Framing Design Standards:

1. Wall Studs: AISI S211.
2. Lateral Design: AISI S213.

C. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

## 2.2 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST33H, ST50H.
2. Coating: G60.

B. Steel Sheet for Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 33, 50.
2. Coating: G60.

## 2.3 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch.
2. Flange Width: 1-3/8 inches, minimum.
3. Section Properties: As indicated.

## 2.4 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, or ASTM A 780.

B. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

## 2.5 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.
  - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
  - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.3 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

## SECTION 05 45 23

### HEALTHCARE METAL SUPPORTS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Work Results:
  - 1. New medical equipment support system at ceilings as indicated.
  - 2. Cold-formed metal slotted channel framing material, fittings and related accessories for above ceiling support of boom for medical equipment.
  - 3. Labor, supervision, engineering and fabrication required for installation of the medical support system in accordance with the Drawings and as specified herein.
- B. Related Requirements:
  - 1. Miscellaneous Structural Steel: Section 05 12 13 Structural Steel Framing.

##### 1.02 REFERENCES

- A. Reference Standards: See Section 01 42 00. Comply with following:
  - 1. American Iron and Steel Institute (AISI) Standards: [www.steel.org](http://www.steel.org).
    - a. AISI S100-16 - North American Specification for the Design of Cold-Formed Steel Structural Members.

##### 1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Submit for the following:
  - 1. Slotted channel framing system components and accessories.
- C. Shop Drawings: Submit shop and assembly drawings.

##### 1.04 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer's Qualifications: The manufacturer shall have minimum 5 years experience manufacturing slotted channel support systems.
    - a. All system components shall be supplied by a single manufacturer.
  - 2. Installer's Qualifications: Installer shall be a manufacturer trained and authorized representative/installer with minimum 5 years experience in the installation of support systems of this size and complexity.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver all material to site in original factory packaging to avoid damaging the finish.
- B. Storage and Handling Requirements: Protect all components from the elements at site by sheltering or covering.

## 1.06 GUARANTEE

- A. Provide separate guarantees from both manufacturer and erector, valid for one year, against defects from manufacture or installation of the medical support system.

## PART 2 PRODUCTS

### 2.01 SLOTTED CHANNEL AND STRUT SYSTEM

- A. Basis of Design Strut System Manufacturer: Unistrut; [www.unistrut.us.com](http://www.unistrut.us.com), unit of Atkore International, Inc.
- B. Components: Standard components by system manufacturer. Types and model numbers as indicated on the Drawings.
- C. Materials:
  - 1. Channel Members: ASTM A570, Grade 33, ASTM A653, Grade 33, or A446, Grade A.
  - 2. Fittings: ASTM A575, A576 or A36.
- D. Finish system components in accordance with one of the following standards.
  - 1. Green: Rust inhibiting acrylic enamel paint applied by electrostatic deposition, after cleaning and phosphating and thoroughly baked. Finish to withstand minimum 400 hours salt spray when tested in accordance with ASTM B117.
  - 2. Pre-Galvanized: Zinc coated by hot dip process prior to roll forming in accordance with ASTM A653, Class G90.

### 2.02 STEEL SHAPES

- A. Steel Angles and Plates: ASTM A36.

### 2.03 STEEL FASTENERS AND WELDING MATERIALS

- A. Bolts: ASTM A307.
- B. Nuts: ASTM A563.
- C. Washers: ASTM F436. Provide flat circular washers or square or rectangular beveled washers as indicated or required for each bolted connection.

### 2.04 STEEL FABRICATION

- A. Steel Fabrication and Shop Painting: Comply with Section 05 12 00.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Inspect the work area prior to installation. Do not proceed until work area conditions are satisfactory.



### 3.02 PREPARATION

- A. Field Measurements: Take measurements on site as required for correct fabrication and installation. Be responsible for errors in fabrication and for correct fit of steel components and slotted channel and strut system.

### 3.03 INSTALLATION

- A. Steel Plates, Angles, and Fabrications: Weld or bolt items securely in place or otherwise fasten as indicated on the Drawings and accepted shop drawings.
  - 1. Field Welds: Grind smooth and touch up with red primer.
- B. Slotted Channel System: Install system components into final position true to line, level and plumb, in accordance with approved shop drawings and as indicated. Securely anchor to support framing as indicated.
  - 1. Make all connections between components with manufacturer's standard connection bolts and hardware unless indicated otherwise.
  - 2. Tighten all connections to their recommended torques.
  - 3. Do not weld to cold-formed steel components unless so indicated explicitly on the Drawings.

### 3.04 CLEANUP

- A. Upon completion of this section of work, remove all protective wraps and debris. Repair any damage due to installation.

### 3.05 PROTECTION

- A. Protect work from damage during installation.

END OF SECTION



**SECTION 05 50 00  
METAL FABRICATIONS**

**PART 1 GENERAL**

**1.01 SUMMARY**

**A Section Includes:**

1. All miscellaneous angles, channels, tubes and plates as indicated and required, and not indicated and specified as structural steel.

**B Related Requirements:**

1. Post-Installed Concrete Anchors: Section 05 05 19.
2. Miscellaneous Structural Steel: Section 05 12 53.
3. Field Painting: Section 09 91 23 Interior Painting.

**1.02 REFERENCES**

**A General Requirements: Refer to Section 01 42 00.**

**B Reference Standards: Comply with the following except as otherwise specified in this Project Manual.**

1. American Institute of Steel Construction (AISC):
  - a. Design, Detailing, and Fabrication: ANSI/AISC 360-16 - Specification for Structural Steel Buildings.
  - b. AISC 303-10 - Code of Standard Practice for Steel Buildings and Bridges, limited to the following:
    - 1) Fabrication, Delivery and Erection of Steel: Comply with Sections 5 through 8.
    - 2) Fabrication, Erection, and Dimensional Tolerances for Exposed Steel Fabrications: Comply with Section 10.
2. American Welding Society (AWS) Standards:
  - a. AWS D1.1/D1.1M:2020 – Structural Welding Code – Steel.
3. Society for Protective Coatings (SSPC):
  - a. SSPC-PA 1 - Shop, Field and Maintenance Painting of Steel.

**1.03 ACTION SUBMITTALS**

**A Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.**

**B Product Data: Submit product data for all manufactured stock items specified under this Section, including the following.**

1. Anchorage and suspension assembly for CAV box.

**C Shop Drawings: Submit for all custom fabricated items under this Section.**

1. Shop drawings shall clearly indicate the following:
  - a. Profiles, sizes, spacing, and locations of members.
  - b. Connections, attachments, and anchorages.
  - c. Size and type of fasteners.
  - d. Finishes, coatings and shop painting.
2. Include erection drawings, elevations and details where applicable.
3. Indicate weld lengths and sizes.

**1.04 QUALITY ASSURANCE**

**A Qualifications:**

1. Welder Qualifications: Welding shall be performed only by certified welding operators currently qualified in accordance with the testing procedures of AWS D1.1 for the weld types and positions required for the fabrications and installations indicated.

**1.05 DELIVERY, STORAGE, AND HANDLING**

**A General Requirements: Comply with Section 01 60 00 - Product Requirements.**

**B Storage and Handling Requirements:**

1. Store metals above ground on platforms, skids, or other supports. Protect metals from corrosion.

2. Store other materials in weathertight and dry place, until ready for use.

## **PART 2 PRODUCTS**

### **2.01 CARBON STEEL MATERIALS**

Unless otherwise noted on design drawings.

- A Carbon Steel Shapes, Bars and Plates: ASTM A36.
- B Steel Pipe and Tubing: ASTM A53, Grade B, or A500, Grade C, minimum wall thickness 11 gage.
- C Threaded Rod: ASTM A36.
- D Carbon Steel Fasteners and Anchors:
  1. Bolts: ASTM A307.
  2. Nuts: ASTM A563.
  3. Washers: ASTM F436.
- E Welding Materials for Carbon Steel:
  1. Filler Metals for Welding: Meet requirements of AWS D1.1.
  2. Welding Electrodes: AWS 5.1 or A 5.5.

### **2.02 FABRICATION**

- A Exposed Steel Fabrications: Interior and exterior steel fabrications and connections which will remain exposed and subject to normal view by the public or occupants of the completed structure shall be subject to all requirements for Architecturally Exposed Structural Steel specified in Section 10 of the AISC Code of Standard Practice.
- B Shop Assembly: Fabricate custom metal fabrications as indicated, scheduled or listed in Article 1.01.
  1. Fabricate in accordance with details and accepted shop drawings.
  2. Provide miscellaneous items of metal work indicated or as necessary to complete work.
  3. Materials: New stock of types and sizes indicated.
  4. Make cuts clean and sharp with wire edges ground smooth. Provide straight, rigid, and tight work, free from defects.
  5. Close exposed ends of steel pipe or tubing with welded caps.
  6. Verify dimensions on site prior to shop fabrication.
  7. Fabricate items with joints neatly fitted and properly secured.
  8. Fit and shop assemble, in largest practical sections, for delivery to site.
  9. Exposed mechanical fastenings shall be flush, countersunk screws or bolts, unobtrusively located, consistent with design of structure, except where specifically noted otherwise.
  10. Make exposed joints flush butt-type, hairline joints where mechanically fastened.
  11. Supply components required for proper anchorage of metal fabrications. Fabricate anchorage and related components of same material and finish as metal fabrication, unless otherwise specified or detailed.
  12. Welding: AWS D1.1. Miter and cope intersections and weld all around. Remove splatter, grind exposed welds to blend and contour surfaces to match those adjacent.
  13. Substitutions: Where exact sizes and weights called for are not available, secure Architect's acceptance of suitable sizes prior to proceeding.

### **2.03 SHOP FINISHES**

- A Shop Painting for Temporary Corrosion Protection of Carbon Steel Fabrications Not Receiving Field-Applied Topcoat: Follow SSPC-PA 1.
  1. Surface Preparation:
    - a. After fabrication and shop assembly, clean off all oil and grease in accordance with SSPC-SP1 Solvent Cleaning procedures.
    - b. Remove loose rust, loose mill scale and weld spatter, slag or flux deposits in accordance with SSPC-SP2 Hand Tool Cleaning procedures.

2. Shop Painting: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - a. Shop Paint: Fabricator's standard lead- and chromate-free, nonasphaltic, rustinhibiting primer.
- B Shop Priming Carbon Steel Fabrications Indicated to Receive Field-Applied Intermediate Coat and Topcoat: Follow SSPC-PA 1.
  1. Surface Preparation: After fabrication and shop assembly, clean off all loose rust, loose mill scale and weld spatter, slag or flux deposits in accordance with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning procedures.
  2. Shop Painting: Immediately after surface preparation, apply primer according to manufacturer's written instructions. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
    - a. Primer:
      - 1) Primer Not Specified Elsewhere: Fast drying, high solids, low VOC, heavy metal free, rust inhibitive, universal, alkyd metal primer compatible with either alkyd or acrylic topcoats.
    3. Primer Coating Thickness: Where not otherwise specified, provide dry film thickness within range recommended by primer manufacturer's published product data.
- C Omit shop paint on the following surfaces, as applicable:
  1. Omit shop paint on surfaces to be enclosed in concrete, surfaces within two inches of a field weld location, and surfaces to receive welded studs.
- D Stainless Steel Finishes: As selected by Architect from the following.
  1. Stainless Steel Plate, Sheet and Strip: ASTM A480, mill finish.
  2. Textured or Embossed Sheet or Strip: ASTM A947M-16.
  3. Surface Roughness:
    - a. Acceptable Surface Roughness for Smooth Finishes: Ra 0.5 microns or less.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A Weld or bolt items securely in place or otherwise fasten as indicated on the Drawings or accepted shop drawings. Include items indicated, scheduled or listed in Article 1.01.
- B Install items square and level, accurately fitted and free from distortion or defects.
- C Field Welds: Perform field welding in accordance with AWS D1.1.
  1. Painted Fabrications: Grind smooth and touch up with compatible primer.

#### **3.02 ADJUSTMENTS**

- A Repair of Defective Work: Remove stained or otherwise defective work. Replace with new material.

**END OF SECTION**

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**SECTION 06 10 00**  
**ROUGH CARPENTRY**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Framing with dimension lumber.
  - 2. Framing with engineered wood products.
  - 3. Wood blocking.

**1.3 DEFINITIONS**

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Timber: Lumber of 5 inches nominal or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. WCLIB: West Coast Lumber Inspection Bureau.
  - 2. WWPA: Western Wood Products Association.

**1.4 SUBMITTALS**

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSA Board of Review.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
  - 1. Engineered wood products.

**1.5 QUALITY ASSURANCE**

- A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
  - 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 4. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
  - 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

### 2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPAC2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPAC31 with inorganic boron (SBX).
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.



2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood floor plates that are installed over concrete slabs-on-grade.

## 2.3 TIMBER FRAMING

- A. Provide timber framing complying with the following requirements, according to grading rules of grading agency indicated:
  1. Species and Grade: Douglas fir-larch; Grade as indicated on the Drawings; WCLIB, or WWPA.

## 2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  1. Blocking.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species, unless noted otherwise on plans.
- C. For blocking not used for attachment of other construction, use No. 2 grade lumber (unless noted otherwise) of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
  1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

## 2.6 METAL FRAMING ANCHORS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by one of the following:
  - 1. Alpine Engineered Products, Inc.
  - 2. Cleveland Steel Specialty Co.
  - 3. Harlen Metal Products, Inc.
  - 4. KC Metals Products, Inc.
  - 5. Simpson Strong-Tie Co., Inc.
  - 6. Southeastern Metals Manufacturing Co., Inc.
  - 7. USP Structural Connectors.
- B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
  - 1. Use for interior locations where stainless steel is not indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
- E. Do not splice structural members between supports, unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
  - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal-thickness.

- H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.10.1, "Fastening Schedule" per the California Building Code National Design Specification for Wood Construction (NDS) and Special Design Provisions for Wind and Seismic (ANSI/AWC SDPWS)
- K. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.
- L. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

### 3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

### 3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size furring vertically at 16 inches.

### 3.4 RAFTER FRAMING INSTALLATION

- A. Rafters: Notch to fit exterior wall plates and use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
  - 1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
  - 2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.

- B. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal-size boards between every third pair of rafters, but not more than 48 inches. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.
- C. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions, if any.

### 3.5 TIMBER FRAMING INSTALLATION

- A. Install timber with crown edge up and provide not less than 4 inches of bearing on supports. Provide continuous members, unless otherwise indicated; tie together over supports as indicated if not continuous.
- B. Install wood posts using metal anchors indicated.

### 3.6 PROTECTION

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION 06 10 00**

**SECTION 06 41 00**  
**ARCHITECTURAL WOOD CASEWORK**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A Specially fabricated cabinet units.
- B Hardware.
- C Factory finishing.

1.02 RELATED REQUIREMENTS

- A Section 01 61 65 - Low-Emitting Material Requirements
- B Section 05 05 19 - Post-Installed Concrete Anchors: Base Cabinet Anchors
- C Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- D Section 12 36 00 - Countertops.

1.03 REFERENCE STANDARDS

- A Definitions: The following definitions apply to plastic-laminate-clad casework:
  - 1. Exposed portions of casework include all surfaces visible when doors and drawers are closed and all visible members in open shelf cases.
  - 2. Semi-exposed portions of casework includes those members behind doors, such as shelves, divisions, interior faces of ends, case back, drawer sides, backs and bottoms and the back face of doors. Tops of cases 6'-6" or more above floor shall be considered as semi-exposed. All visible members behind glass doors also shall be considered as semi-exposed portions.
  - 3. Concealed portions of case work include sleepers, web frames, dust panels and other surfaces not usually visible after installation.
- B Reference Standards: See section 01 42 00. Comply with the following:
- C ANSI A208.1 - American National Standard for Particleboard 2016.
- D ANSI A208.2-2016 - Medium Density Fiberboard (MDF) for Interior Applications
- E ASTM E1333 - 14 - Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber
- F ATCM (Airborne Toxic Control Measure) California Environmental Protection Agency
- G AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014, with Errata (2018).
- H AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).
- I BHMA A156.9 - American National Standard for Cabinet Hardware 2015.
- J WI (CSIP) - Certified Seismic Installation Program (CSIP) Current Edition.

1.04 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
  - 1. Scale of Drawings: 1-1/2 inch to 1 foot ( 125 mm to 1 m ), minimum.
  - 2. Provide the information required by AWMAC/WI (NAAWS).
  - 3. Include certification program label.
- C Product Data: Provide data for hardware accessories.
- D Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches ( 300 mm ) square, illustrating proposed cabinet, countertop and shelf unit substrate and finish.
- E Samples: Submit actual sample items of proposed pulls, hinges, shelf standards and locksets, demonstrating hardware design, quality, and finish.
- F Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- G Certificates:

1. Particleboard and MDF: Submit third-party certification that formaldehyde emissions comply with Phase 1 standards of CARB Air Toxic Control Measure (ATCM) for Formaldehyde Emissions from Composite Wood Products, and with ANSI A208.1 or A208.2 as applicable, when tested in accordance with ASTM E1333.

#### 1.05 QUALITY ASSURANCE

- A Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
  2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
  3. Single Source Responsibility: Provide and install this work from single fabricator.
- B Quality Certification:
1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
    - a. WI Certified Seismic Installation Program:
      - 1) Before walls are closed up, provide a written Woodwork Institute Certified Seismic Installation Program report confirming that backing is provided in all locations required for casework installation or identifying those locations where backing is missing or improperly located.
      - 2) On completion of installation, provide a Woodwork Institute Certified Seismic Installation Program Certificate identifying the work covered and certifying the installations meets the requirements of the WI CSIP attachment details and schedules.
      - 3) All fees charge by the Woodwork Institute for its Certified Seismic Installation Program are the responsibility of the millwork installer and shall be included in their bid.
    2. Provide designated labels on shop drawings as required by certification program.
    3. Provide designated labels on installed products as required by certification program.
    4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
    5. Replace, repair, or rework all work for which certification is refused.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A General Requirements: Comply with Section 01 60 00.
- B Delivery and Acceptance Requirements:
1. Humidity: Do not deliver material until building or storage area is enclosed and sufficiently dry to prevent damage from excessive changes in moisture content. Maintain wood material storage area relative humidity at between 25 percent and 55 percent.
  2. Storage and Handling Requirements: Comply with NAAWS Section 2. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective covering.

#### 1.07 FIELD CONDITIONS

- A During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

### **PART 2 PRODUCTS**

#### 2.01 PRODUCT OPTIONS

- A Substitutions: See Section 01 60 00 - Product Requirements.
1. Submit in accordance with Section 01 25 00.
- B Single Source Responsibility: Provide and install this work from single fabricator.

## 2.02 CABINETS

- A Quality Standard: Custom Grade, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.

## 2.03 WOOD-BASED COMPONENTS

- A Plywood:
  - 1. Plywood to Receive Plastic-Laminate: Commercial Standard Good Grade, minimum 3/4-inch thick after lamination.
  - 2. Maximum Allowable Formaldehyde Emissions: 0.05 ppm.
- B Particleboard: ANSI A208.1, Grade M3 or better. Matte formed wood particleboard, 40-45# density industrial grade with sealer and lacquer finish.
  - 1. Required Emissions Classification:
    - a. No-Added Formaldehyde (NAF) and/or Ultra-Low Emitting Formaldehyde (ULEF) as approved by CARB.
  - 2. Acceptable Manufacturers and Products:
    - a. Flakeboard Company Limited; [www.flakeboard.com](http://www.flakeboard.com).
      - 1) Duraflake.
      - 2) NAUF Panels: Terra Particleboard.
      - 3) ULEF Panels: Vesta Particleboard.
    - b. SierraPine; [www.sierrapine.com](http://www.sierrapine.com) - Encore.
  - 3. Thickness: 3/4-inch.
  - 4. Cabinet Interiors: Acrylic coated 45-47 pound density industrial particleboard.
  - 5. Accepted substitute in accordance with Section 01 25 00.
- C Medium-Density Fiberboard (MDF): ANSI A208.2.
  - 1. Grade: Grade 155 MR-50.
  - 2. Required Emissions Classification:
  - 3. Required Emissions Classification:
- D Cabinet Top and Bottom: Full sub tops (rails not acceptable) and bottoms shall be particleboard, 3/4-inch thick, laminated on the interior with low pressure laminate cabinet liner with a backer sheet of a neutral color on the unexposed surface. The interior surface of sink cabinet bottoms shall be laminated with high pressure laminate cabinet liner. The bottom surface of all upper cabinets shall be low pressure laminate cabinet liner. Front edges to be 3mm PVC edging (laminated not acceptable). All tops shall be solid except for sink base tops which shall have a 1-inch by 1-inch by 1/8-inch angle iron front rail. All cabinets over 42 inches and up to 72 inches in height shall be supplied with a finished 3/4-inch continuous top.
- E Cabinet Ends: Unexposed cabinet ends shall be particleboard, 3/4-inch thick, laminated on the interior with low pressure laminate cabinet liner and a backer sheet of a neutral color on the exterior unexposed surface. Exposed cabinet ends shall be laminated with vertical surface cabinet liner on the interior. Holes shall be drilled for adjustable shelf clips 32mm (1-1/4-inch) on center. Front edges to be banded with 3mm PVC edging (laminated is not acceptable). Bottom edges of wall cabinet ends to be banded with 3mm PVC edging (laminated not acceptable). Ends to be bored to accept doweled top and bottom. All ends to be rabbeted to accept recessed back.
- F Fixed Intermediate and Adjustable Shelves: Particleboard, 3/4-inch thick unless otherwise indicated, laminated on both sides with low pressure laminate cabinet liner (closed door cabinets). Color shall be Light Beige or Dove Grey on both surfaces. Front edges to be banded with 3mm PVC edging. Adjustable shelves up to 30 inches wide are 3/4-inch thick. Shelves wider than 30 inches are 1-inch thick. Open shelf unit cabinet shelves to be laminated with high pressure decorative laminate.
- G Cabinet Back: Standard recessed cabinet back to be 1/4-inch thick prefinished hardboard. Color to match cabinet interior. All sink cabinets to have split back, removable from inside.

Exposed exterior back on fixed or movable cabinets to be particleboard, 3/4-inch thick, laminated with high pressure laminate on the exterior surface and Light Beige or Dove Grey colored high pressure laminate cabinet liner on the interior surface. Interior back surface on open wall cabinets to be high pressure decorative laminate.

- H Cabinet Doors and Drawer Fronts: Particleboard, 3/4-inch thick, shall be laminated with vertical surface high pressure laminate on the exposed surface and colored high pressure laminate cabinet liner on the interior surface. Door and drawer edges to be banded with 3mm PVC edge banding, hot melt glue applied. Double doors shall be used on all cabinets in excess of 24 inches in width.
- I Drawers: Sides, back and subfront, shall be particleboard, 1/2-inch thick, laminated with colored polyester laminate. The back and subfront shall be doweled and glued into the sides. No staples or nails permitted. Dowels shall be spaced 32mm (1-1/4-inch). Dowels to be hardwood, laterally fluted, with chamfered ends and a minimum diameter of eight (8) millimeters. Top edge to be banded with PVC edging. Drawer bottom to be Light Beige or Dove Grey color, 1/4-inch thick, prefinished hardboard, let into subfront, sides and back. Paper storage drawers to be heavy duty 3/4-inch particleboard construction with 100 pound full extension slides, plywood reinforcement stiffener at bottom and a retaining hood at the rear of each drawer.
- J Exposed Edges: Exposed cabinet body edges shall be covered with PVC edgeband.
  - 1. Plastic laminate is not acceptable for cabinet body edges.
  - 2. Door and drawer front edges shall be covered with 3mm PVC edge-banding.
  - 3. PVC edgeband shall be applied with hot melt glue, no exceptions.
- K Additional Seismic Requirements for Casework Fabrication: Comply with NAAWS, 10.6.4E.
  - 1. Nailers shall be minimum 3/4-inch thickness, of veneer core plywood, Structural 1 grade, MDF Grade 150 or Douglas Fir with a specific gravity of 0.5 or higher.
  - 2. Tall storage cabinets shall have a fixed shelf approximately mid-height securely attached to the cabinet back and nailer.
  - 3. No-Added Formaldehyde (NAF) and/or Ultra-Low Emitting Formaldehyde (ULEF) as approved by CARB.
  - 4. Acceptable Manufacturers and Products:
    - a. Flakeboard Company Limited; [www.flakeboard.com](http://www.flakeboard.com).
      - 1) Premier MDF.
      - 2) NAUF Panels: Terra MDF.
      - 3) ULEF Panels: Vesta MDF.
    - b. SierraPine; [www.sierrapine.com](http://www.sierrapine.com) - Medite II.
    - c. Thickness: 3/4-inch unless indicated otherwise.
    - d. Accepted substitute in accordance with Section 01 25 00.
- L Fire-Rated Medium-Density Fiberboard (MDF): ANSI A208.2, UL approved, Class 1 fire rated panels. Use where Class 1 paneling is required by code.
  - 1. Grade: Grade 115 or better.
    - a. Moisture-Resistant Panels: Grade 115 or better. Use for exposed MDF in kitchens, baths, laboratories, and similar high humidity applications.
  - 2. Required Emissions Classification:
    - a. No-Added Formaldehyde (NAF) and/or Ultra-Low Emitting Formaldehyde (ULEF) as approved by CARB.
  - 3. Acceptable Manufacturers and Products:
    - a. Flakeboard Company Limited; [www.flakeboard.com](http://www.flakeboard.com). - Premier FR.
    - b. SierraPine; [www.sierrapine.com](http://www.sierrapine.com) - Medite II.
  - 4. Thickness: 3/4-inch unless indicated otherwise.
  - 5. Accepted substitute in accordance with Section 01 25 00.
- M Hardboard: ANSI A135.4. Tempered Grade.



N Wood fabricated from old growth timber is not permitted.

## 2.04 LAMINATE MATERIALS

### A Manufacturers:

1. Panolam Industries International, Inc; Nevamar Standard HPL: [www.panolam.com/#sle](http://www.panolam.com/#sle).
2. Panolam Industries International, Inc; Pionite Standard HPL: [www.panolam.com/#sle](http://www.panolam.com/#sle).
3. Wilsonart LLC; HPL: [www.wilsonart.com/#sle](http://www.wilsonart.com/#sle).
4. Colors: See Finish Legend on Drawings.
5. Accepted substitute in accordance with Section 01 25 00.

## 2.05 COUNTERTOPS

A Countertops are specified in Section 12 36 00.

## 2.06 ACCESSORIES

A Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.

1. Color: As selected by Architect from manufacturer's full range.

B Grommets: Standard plastic, painted metal or rubber grommets for cut-outs, in color to match adjacent surface.

## 2.07 HARDWARE

A Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch ( 25 mm ) spacing adjustments.

C Fixed Specialty Shelf Supports:

1. Material: Steel.

D Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers ( "U" shaped wire pull, steel with chrome finish, 100 mm centers ).

1. Match existing. Submit samples to architect for approval.

E Drawer Slides:

1. Type: Full extension with overtravel.
2. Static Load Capacity: Commercial grade.
3. Mounting: Side mounted.
4. Stops: Integral type.
5. Features: Provide self closing/stay closed type.
6. Manufacturers:

a. Accuride International, Inc; 3640A Heavy-Duty Over-Travel Slides: [www accuride.com/#sle](http://www accuride.com/#sle).

b. Knappe & Vogt Manufacturing Company; Heavy-Duty Drawer Slides: [www.knapeandvogt.com/#sle](http://www.knapeandvogt.com/#sle).

c. Substitutions: See Section 01 60 00 - Product Requirements.

F Hinges: 5 knuckle 2-1/4 inch, overlay type, hospital tip, 0.095-inch thick steel with dull chrome, finish.

1. Manufacturers:

a. Grass America Inc; Institutional Hinges: [www.grassusa.com/#sle](http://www.grassusa.com/#sle).

b. Hettich America, LP; [www.hettich.com/#sle](http://www.hettich.com/#sle).

c. Blum, Inc: [www.blum.com/#sle](http://www.blum.com/#sle).

d. Häfele America Co.

e. Mepla, Inc.

f. Accepted substitute in accordance with Section 01 25 00.

2. Hinges shall have a minimum of eight (8) edge and leaf fastenings.

3. Doors 48 inches and over in height shall have three (3) hinges per door. Doors 66 inches and over shall have four (4) per door.

## 2.08 FABRICATION

- A General: Fabricate plastic laminate faced casework to dimensions, profiles and details shown. Assemble units in the shop in as large of components as practicable to minimize field cutting and jointing. All joints to be doweled and glued. All edge banding called for in this Section shall be 3mm PVC hot melt glue applied. Top edges of interior drawer boxes may be 1/2mm hot melt glue applied.
  - 1. Plastic Laminate Faced Cabinets: Comply with Section 10 of NAAWS for Custom Grade.
  - 2. Provide and install hardware as indicated and specified.
  - 3. Cabinet Construction Type: Frameless.
  - 4. Door Interface Style: Flush overlay.
- B Preparation: Obtain field measurements and verify dimensions are as indicated on shop drawings before fabricating casework.
- C Coordination: Coordinate with plumbing and electrical rough-in.
- D Core Material: As indicated on Drawings. Fabricate panels with plastic laminate on both sides or balancing sheet on concealed faces.
  - 1. Particle Board: Minimum density 45 lb. particle board, minimum 3/4-inch thick before lamination.
  - 2. Plywood: Commercial Standard Good Grade, minimum 3/4-inch thick before lamination.
  - 3. MDF: Minimum 3/4-inch thick before lamination.
- E Cabinet Joinery: Tops and bottoms shall be joined to cabinet ends using a minimum of six (6) dowels for 24-inch deep cabinets and a minimum of four (4) dowels for 12-inch deep cabinets. All dowels are to be hardwood laterally fluted, with chamfered end and a minimum diameter of ten (10) millimeters. Dowels with less than 10mm diameter are not acceptable. Internal cabinet components such as fixed horizontals, rails and verticals are to be doweled in place. Dowels are to be securely glued and cabinets clamped under pressure during assembly to assure secure joints and cabinet squareness.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A Verify adequacy of backing and support framing.
- B Field Measurements: Verify location and sizes of utility rough-in associated with work of this section.

### 3.02 INSTALLATION

- A Install work in accordance with AWMAC/WI (NAAWS) requirements for grade indicated.
- B Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C Use fixture attachments in concealed locations for wall mounted components.
- D Use concealed joint fasteners to align and secure adjoining cabinet units.
- E Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch ( 0.79 mm ). Do not use additional overlay trim for this purpose.
- F Secure cabinets to floor using appropriate angles and anchorages.
- G Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

### 3.03 ADJUSTING

- A Adjust moving or operating parts to function smoothly and correctly.
  - 1. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- B All nicks, chips, and scratches in the finish shall be filled and retouched. Damaged items that cannot be repaired shall be replaced.
- C Repair or remove and replace defective work as directed upon completion of installation.

### 3.04 CLEANING

- A Clean casework, counters, shelves, hardware, fittings, and fixtures.

B Repair minor damage per plastic laminate manufacturer's recommendations. Replace other damaged parts or units.

3.05 PROTECTION

A Protect casework and tops from damage by other trades until acceptance of the work by the Owner.

**END OF SECTION**

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**SECTION 07 02 52**  
**CUTTING AND PATCHING OF SINGLE MEMBRANE ROOFING**

**PART 1 GENERAL**

**1.01 SUMMARY**

**A Section Includes:**

1. Selective removal of existing roofing, rigid insulation, and sheet metal flashings down to existing structural concrete deck in areas indicated.
2. Patching and flashing existing modified bituminous membrane roofing and insulation around new roof openings.

**B Related Sections:**

1. Cutting and Patching: Section 01 73 29.
2. Selective Demolition: Section 02 41 19.
3. New Roof Blocking: 06 10 00 - Rough Carpentry.
4. Sheet Metal Flashing: Section 07 60 00 - Flashing And Sheet Metal.

**1.02 REFERENCES**

**A General Requirements:** Refer to Section 01 42 00.

**B Definitions:** Accept as otherwise specified, standard roofing terminology as defined by ASTM D1079 "Standard Terminology Relating to Roofing and Waterproofing" applies to this Section.

1. Remove: Detach from existing construction and legally dispose off-site, unless indicated to be removed and reinstalled.

**C Reference Standards:** Comply with the following except as otherwise specified in this Project Manual.

1. ASTM International Standards:
  - a. ASTM C1289-19 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
2. Factory Mutual Insurance Company Reference Standards:
  - a. FM Approvals LLC; [www.fmapprovals.com](http://www.fmapprovals.com) – FM Approval Standards:
    - 1) FMG Approval Guide; [www.approvalguide.com](http://www.approvalguide.com).
    - 2) Class Number 4470 – Approval Standard for Class 1 Roof Covers.
  - b. FM Global (FMG) Operating Standards: [www.fmgglobal.com](http://www.fmgglobal.com).
    - 1) FMG Property Loss Prevention Data Sheet 1-28 – Wind Design, January 2012.
    - 2) FMG Property Loss Prevention Data Sheet 1-28R, 1-29R – Roof Systems, September 1998.
    - 3) FMG Property Loss Prevention Data Sheet 1-29 – Roof Deck Securement and Above-Deck Roof Components, April 2016.
3. Underwriters Laboratories, Inc. Reference Standards:
  - a. Roofing Materials and Systems Directory.
  - b. UL 55-A – Materials for Built-Up Roof Coverings, 2004 edition.

**D Guide References and Standard Practices:**

1. National Roofing Contractors Association (NRCA) – The NRCA Roofing Manual: Membrane Roof Systems – 2015.

**1.03 ADMINISTRATIVE REQUIREMENTS**

**A Coordination:**

1. Coordinate work activities daily with Owner so Owner can place protective dust or water leakage covers over sensitive equipment or furnishings, shut down HVAC if needed, and evacuate occupants from below the work area if desired. Provide not less than 72 hours' notice of activities that may affect Owner's operations.
2. Coordinate work of this Section with work of other sections. Coordinate placement of wood blockings, inserts, nailing strips, cants, drain pan linings, etc. Coordinate roof

penetrations, equipment bases and other conditions as required.

- a. Roof drains or scuppers that are not at proper level to drain finished roof shall be reset before proceeding by contractors responsible for installation.

**B Roofing Conference: See Section 01 31 00.**

1. Before beginning roofing removal and patching, hold conference with General Contractor's Superintendent, roofing contractor(s), and roofing manufacturer's representatives. Notify Architect and Owner's Representative of meeting at least 10 days in advance.
2. Discuss all matters pertaining to roofing work, including procedures for removal of existing roofing, detailing, preparation, coordination between trades, weather restrictions, structural loading limitations of roof deck during and after roofing, installation techniques and procedures, phasing and scheduling.
  - a. Review temporary protection requirements.
  - b. Review roof drainage during each stage of roofing work, including roof drain plugging and plug removal procedures.
  - c. Review Owner notification requirements.
  - d. Review filtering of HVAC air intakes.
3. Take minutes and distribute to attending parties and Architect.

**1.04 ACTION SUBMITTALS**

- A Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B Product Data: Prior to starting the roofing, the applicator shall submit to the Architect through the General Contractor copies of the manufacturer's specifications covering materials he proposes to apply. Submit evidence of certified applicator status with specifications.

**1.05 INFORMATIONAL SUBMITTALS**

- A Procedures: Submit for information and verification in accordance with Section 01 33 00.
- B Certificates: Submit evidence of certified applicator status for roofing product proposed for application.

**1.06 CLOSEOUT SUBMITTALS**

- A Procedures: Submit for Project Record in accordance with Section 01 78 00.
- B Warranties: At completion of the Project, submit roofing and flashing warranties as specified.

**1.07 QUALITY ASSURANCE**

- A Qualifications:
  1. Installer Qualifications: Employ original roofing subcontractor or other qualified subcontractor authorized to make revisions to existing roofing without affecting or limiting original warranty, guarantee or bond.

**1.08 DELIVERY, STORAGE, AND HANDLING**

- A General Requirements: Comply with Section 01 31 19 - Project Meetings.
- B Delivery and Acceptance Requirements: Deliver materials in manufacturer's original, unopened containers with labels intact and legible.
- C Storage and Handling Requirements: Handle rolled goods to prevent damage to edges or ends. Store rolled goods on end. Store off the ground and keep covered with waterproof covering. Materials that become wet will be subject to rejection.

**1.09 9 AMBIENT CONDITIONS**

- A Comply with manufacturer's recommendations.
- B Do not apply roofing during wet weather.

**1.10 WARRANTY**

- A Existing Roof Warranty: Submit evidence that existing roof warranty has not been voided by patching.

- B New Warranty: Roofing subcontractor shall provide and deliver a warranty against defects in materials and workmanship in patched roofing and flashings for a period of two years from completion of work.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A Acceptable Modified Bituminous Membrane Roofing Materials Manufacturers:
  - 1. DERBIGUM Americas, Inc..
  - 2. Firestone Building Products Company; www.firestonebpco.com.
  - 3. GAF Materials Corporation; www.gaf.com.
  - 4. Johns Manville, Inc www.specjm.com.
  - 5. Siplast; www.siplast.com.
  - 6. TAMKO Building Products, Inc.; www.tamko.com.
  - 7. Tremco; www.tremcoinc.com
- B Substitution Requests: Required for all manufacturers not named as Acceptable Manufacturer.
  - 1. Submit in accordance with Section 01 25 00.

### **2.02 TEMPORARY ROOFING**

- A Selection of materials and design of temporary roofing is responsibility of Contractor.

### **2.03 ROOF INSULATION**

- A Insulation Type and Thickness: Match existing. Taper where required to maintain slope from edge to edge of new insulation.
  - 1. Facings: Provide facings as appropriate for torch-applied bitumen roofing system if necessary to match existing roofing type.
  - 2. Fasteners: Provide as recommended by manufacturer to achieve wind resistance rating required by local codes.

### **2.04 ROOF PATCHING SYSTEM**

- A Roof Patching System: Match existing, including minimum number and composition of membrane roofing plies.
  - 1. Add plies if required to provide manufacturer's warranty.
- B Materials: Match existing.
  - 1. Cold Process Adhesive: Modified bituminous membrane compatible, 80 percent minimum solids content.
  - 2. Asphalt: ASTM D312, Steep Grade, Type III, air blown asphalt manufactured specially for roofing.
  - 3. Emulsion: ASTM D1227, Type I emulsion or fibrated emulsion.
  - 4. Surface Material: Gravel to match existing.
- C Flashings: Match existing with system compatible with roofing.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A General: Verify that work of other trades that penetrates roof deck has been completed. Examine surfaces for inadequate anchorage, drainage, foreign material, moisture and unevenness that would prevent the execution and quality of application of roofing system. Do not proceed with application of roofing system until defects are corrected.
- B Acceptance: No roofing shall proceed until the surface to be covered is fully acceptable to the applicator.

### **3.02 PREPARATION FOR SELECTIVE ROOF REMOVAL**

- A Protection:
  - 1. Maintain sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

2. Protect interior spaces from infiltration of dust or debris during demolition of existing roofs and roof patching operations. Include protection of concealed ceiling spaces.
  3. Protect paving and building walls adjacent to hoist prior to starting work with protective covering.
  4. Lap suitable protective covering materials at least 6 inches. Secure protective coverings against wind. Leave protective covering in place for duration of roofing work.
- B Removal of Existing Roofing Gravel: Remove gravel in areas to be patched by spudding down to the top surface of the existing roofing membrane.
- 3.03 SELECTIVE ROOF REMOVAL
- A Extent of Roof Removal, General: Full roof tear-off at areas indicated. Remove all existing roofing material(s), insulation, cover boards, base flashing, metal flashing, and deteriorated wood blocking and legally dispose of offsite.
1. Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.
- B Removal of Roofing: Where indicated on Drawings, remove roofing gravel, roofing, insulation, flashing, and other roof components down to existing structural roof deck.
- C Remove only enough roofing to accommodate the day's work and ensure the exposed area can be made 100 percent watertight at the end of the day or at first sign of inclement weather. Provide temporary roofing when necessary that deck be exposed for extended periods or overnight. Remove temporary roofing membrane before installing new roofing.
- D Do not damage metal counterflashings that are to remain. Replace metal counterflashings damaged during removal with counterflashings of same metal, weight or thickness, and finish as new metal flashing.
- E Roof Drains: Maintain in functioning condition. Prevent debris from entering or blocking roof drains and conductors using roof drain plugs specifically designed for this purpose.
- F Cap and identify exposed utilities, if any.
- 3.04 PREPARATION FOR ROOF PATCHING
- A Surface Preparation: Dry and broom clean before beginning roof patching.
- B Inspect deck and substrates behind removed flashings after tear-off of roofing.
1. If deck surface is not suitable to receive new roofing, or if structural integrity of deck is suspect, immediately notify Architect, and do not proceed with installation until directed by Architect.
  2. If areas of deck surface are noted to exhibit excessive deflection, to be noticeably out-of plane, appear to be conducive to water ponding or poor drainage, or otherwise detrimental to proper performance of roofing system, immediately notify Architect of such areas, and do not proceed with installation until directed by Architect.
  3. If parapet sheathing, curbs, adjoining walls, roof screen supports, or roof-penetrating items have deteriorated or been damaged, immediately notify Architect.
- C Concrete Decks:
1. Verify concrete deck to be visibly dry and free from moisture. Test for moisture by plastic sheet method in accordance with ASTM D4263. Do not proceed with roofing work if moisture condenses under plastic sheet.
  2. Remove all loose aggregate and debris by power broom and/or vacuum and legally dispose of offsite.
- D Roof drains or scuppers that are not at the proper level to drain the finished roof shall be reset before proceeding.
- 3.05 APPLICATION
- A Vapor Barrier: Patch to match existing.



- B Insulation: Fully adhere new insulation to structural roof deck at areas to be patched. Comply with FM 1-90 wind requirements. Install no more insulation at one time than will be protected from rain or snow by installation of roofing membrane on the same day or prior to storm. Install temporary water cutoffs at completion of each day's work and remove upon resumption of work.
  - C Membrane Roofing: Apply, lap and splice in accordance with approved manufacturer's specifications using roofing torch method for heat welding as recommended.
    - 1. Complete installation of roofing system up to line of termination of day's work.
    - 2. Provide three-inch side laps and four-inch end laps.
    - 3. Take precautions to ensure full adhesion to substrate and full adhesion of laps.
  - D Base Flashing: Install in accordance with approved manufacturer's specifications and as detailed. Extend base flashing a minimum of 8 inches up vertical surface and mop or nail in place.
  - E Aggregate: Install poured flood coat and aggregate surfacing in accordance with requirements of roofing system manufacturer. Pour flood coat uniformly over surface. Apply aggregate uniformly and with complete coverage.
  - F Record of Work: The Contractor shall keep a record indicating temperature and moisture conditions and the type and location of work being done during each day of roofing operation.
- 3.06 CLEANING
- A Upon completion, remove bitumen, asphalt and gravel from roof drains and scuppers and from exposed metal and masonry surfaces, gutters, etc.

**END OF SECTION**

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**SECTION 07 21 00  
THERMAL INSULATION**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A Board insulation at cavity wall construction and interior wall with facer providing exposed finish.
- B Batt insulation in interior wall, ceiling and roof construction.
- C Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

- A Section 09 21 16 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

- A ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- B ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- C ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C 2019a.

1.04 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
- C ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- D ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

- A Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); [www.airbarrier.org/#sle](http://www.airbarrier.org/#sle):
  - 1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
  - 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 FIELD CONDITIONS

- A Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

- A Acceptable Manufacturers:
  - 1. Johns-Manville, 800/654-3103; [www.jm.com](http://www.jm.com).
  - 2. Knauf Fiber Glass; 800/825-4434; [www.knaufinsulation.us](http://www.knaufinsulation.us).
  - 3. Owens-Corning, 800/GET-PINK; [www.owenscorning.com](http://www.owenscorning.com).
  - 4. Accepted substitute in accordance with Section 01 25 00.
- B Sound Control Blankets for Partitions: ASTM C665, Type 1, unfaced.
  - 1. Acceptable Products:
    - a. Knauf EcoBatt; [www.ecobatt.us](http://www.ecobatt.us).
    - b. Manville Sound Control Batts.
    - c. Accepted substitute in accordance with Section 01 25 00.
  - 2. Material: Formaldehyde-free inorganic fiber glass bonded with thermoset resin.

## 2.02 APPLICATIONS

- A Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.
- B Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.

## 2.03 BATT INSULATION MATERIALS

- A Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
  - 1. Thickness:
    - a. For Partitions: 3½ inches unless otherwise indicated.
    - b. For Ceilings: 6¼ inches unless otherwise indicated.
  - 2. Flame Spread:
    - a. For Partitions: Maximum 25.
    - b. For Ceilings: Maximum 10.
  - 3. Smoke Developed:
    - a. For Partitions: Maximum 50.
    - b. For Ceilings: Maximum 10.
  - 4. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
  - 5. Formaldehyde Content: Zero.
  - 6. Width: 16 inches or 24 inches to match partition wall stud spacing or joist spacing as applicable and as indicated.
  - 7. Facing: Aluminum foil, flame spread 25 rated; one side.
- C Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
  - 1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B Verify substrate surfaces are flat, free of irregularities or materials or substances that may impede adhesive bond.

### 3.02 BATT INSTALLATION

- A **Install** insulation in accordance with manufacturer's instructions.
- B Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

### 3.03 FIELD QUALITY CONTROL

- A See Section 01 40 00 - Quality Requirements, for additional requirements.
- B Coordination of Air Barrier Association of America (ABAA) Tests and Inspections:
  - 1. Provide testing and inspection required by ABAA Quality Assurance Program (QAP).
  - 2. Notify in ABAA writing of schedule for air barrier work, and allow adequate time for testing and inspection.
  - 3. Cooperate with ABAA testing agency.
  - 4. Allow access to air barrier work areas and staging.
  - 5. Do not cover air barrier work until tested, inspected, and accepted.

3.04 PROTECTION

A Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION**

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## SECTION 07 26 16

### BELOW-GRADE VAPOR RETARDERS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Work Results:
  - 1. Continuous vapor retarder under interior concrete floor slab-on-grade patches.
- B. Related Requirements:
  - 1. Concrete Floor Slab Patching: Section 03 30 53 Miscellaneous Cast-in-Place Concrete.
  - 2. Trenching and Backfilling: Section 31 23 33.

##### 1.02 REFERENCES

- A. General Requirements: Refer to Section 01 42 00.
- B. Definitions: Meaning of the following terms as used in this Section of these Specifications.
  - 1. Perms: Grains/(ft<sup>2</sup>-hr.-inHg).
- C. Reference Standards: Comply with following reference standards as applicable to the Work indicated.
  - 1. ASTM International Standard Specifications and Test Methods; [www.astm.org](http://www.astm.org):
    - a. ASTM E154/E154M-08a(2019) - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
    - b. ASTM E1745-17 – Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- D. Guide References and Standard Practices: Comply with recommendations of the following except as otherwise specified in this Project Manual.
  - 1. American Concrete Institute (ACI) Committee Reports, Guides, Standard Practices, and Commentaries; [www.concrete.org](http://www.concrete.org):
    - a. ACI 302.1R-15 – Guide for Concrete Floor and Slab Construction.
    - b. ACI 302.2R-06 – Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
  - 2. ASTM International Standard Practices:
    - a. ASTM E1643-18a – Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

##### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Slab Saw-Cutting and Trenching: Coordinate with concrete core drilling and saw-cutting work under other sections of the Specifications for verification and location of existing underslab vapor retarder and to ensure that concrete is removed in manner that provides for full six inch laps between existing and new vapor retarder sections.
    - a. Provide for multiple saw-cuts and ensure outside saw-cut depth is controlled and terminates above depth of vapor retarder, leaving at least 6 inches of vapor retarder intact and extending into slab removal area.

- B. Preinstallation Meeting: Conduct conference at Project site in accordance with Section 01 31 00.
  - 1. Meet with underslab vapor retarder installer and manufacturer's representative, concrete floor slab installer, and other installers whose work interfaces with or penetrates underslab vapor retarder.
  - 2. Review methods and procedures related to underslab vapor retarder installation, including manufacturer's written instructions.
  - 3. Review temporary protection requirements for underslab vapor retarder during and after installation.
  - 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

#### 1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Manufacturer's current product data sheets describing products to be supplied with all selected options clearly identified, basic uses, composition and materials, physical properties, precautions and limitations, applicable standards, approvals, and general installation procedures.

#### 1.04 INFORMATIONAL SUBMITTALS

- A. Procedures: Submit for information and verification in accordance with Section 01 33 00.
- B. Manufacturer's Instructions:
  - 1. Submit Manufacturer's installation instructions.
    - a. Submit for underslab vapor retarders before beginning concrete floor slab patching.
    - b. Maintain one additional copy on site until completion of installation.

#### 1.05 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Installer Qualifications: Vapor retarder installer shall have a minimum of two years' experience on equivalent projects.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. General Requirements: Comply with Section 01 60 00 and with Manufacturer's instructions and recommendations.
- B. Storage and Handling Requirements:
  - 1. Vapor Retarder: Protect from damage and keep dry.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS AND MANUFACTURED PRODUCTS

- A. Acceptable Manufacturers and Products:
  - 1. Barrier-Bac, Inc., [www.barrierbac.com](http://www.barrierbac.com) – VB-250, 11 mil, three layer, co-extruded biaxially oriented polyethylene membrane.
  - 2. Fortifiber Corporation, [www.fortifiber.com](http://www.fortifiber.com) - Moistop Ultra 10, 10 mil thickness polyolefin membrane.
  - 3. Reef Industries, Inc., [www.reefindustries.com](http://www.reefindustries.com) - Griffolyn 10 mil, co-extruded polyolefin membrane.



4. Stego Industries, LLC, [www.stegoindustries.com](http://www.stegoindustries.com) - Stego Wrap Class A Vapor Retarder, extruded 10 mil thickness polyolefin membrane manufactured with virgin resins.
5. W. R. Meadows, Inc., [www.wrmeadows.com](http://www.wrmeadows.com) – Perminator 10 Mil Underslab Vapor Barrier, polyolefin-based membrane.

## 2.02 DESCRIPTION

- A. Underslab Vapor Retarder: ASTM E1745, Class B or better with ten mil minimum thickness.
- B. Maximum Allowable Water Vapor Permeance: 0.04 perms when tested in accordance with ASTM E96, ASTM E154, or ASTM F1249.
- C. Puncture Resistance: Minimum 2200 grams when measured in accordance with ASTM D1709, Method B.

## 2.03 ACCESSORIES

- A. Vapor Retarding Seam Tape: Manufacturer's standard for vapor retarder product used.
  1. Water Vapor Transmission Rate: ASTM E96, 0.3 perms or lower.
  2. Color: Contrasting.
- B. Vapor Proofing Mastic.
  1. Water Vapor Transmission Rate: ASTM E96, 0.3 perms or lower.
- C. Pipe Boots: Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic in accordance with manufacturer's instructions.
- D. Perimeter/Edge Seal: Manufacturer's standard.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verification of Conditions: Comply with Section 01 71 16.
  1. Layout: Verify layout of work before beginning installation.
  2. Before saw-cutting slab and trenching, core drill through slab to verify the presence and location of existing underslab vapor retarder.
    - a. If no vapor retarder exists under slab, report existing condition to Architect. Unless otherwise directed, vapor retarder patching work under this Section may be omitted, but alternative measures to ensure vapor impermeability of patched slab may be required, as directed by Architect.
  3. Subgrade: Inspect subgrade to verify elevation and compaction requirements.
- B. Notification: Notify General Contractor of unsatisfactory conditions in writing with copy to Architect.
- C. Acceptance: Beginning of work means acceptance of existing conditions by installer.

### 3.02 PREPARATION

- A. Subgrade Under Slabs and Vapor Retarder: Fine grade to smooth, level surface.
  1. Place approximately 2 inch thickness of fine-graded granular base material over subgrade. Roll or compact to provide smooth and level surface without jagged material protruding which could puncture vapor retarder.

### 3.03 UNDERSLAB VAPOR RETARDER INSTALLATION

- A. General: Place vapor retarder under all interior slab on grade patches.
  - 1. Install in accordance with Manufacturer's recommendations and ASTM E1643.
  - 2. Use widest practical width of film.
- B. Laps: Lap new vapor retarder sheet with existing vapor retarder not less than 6 inches around perimeter of all patches. Tape seams in accordance with manufacturer's instructions.
- C. Penetrations: Not allowed except for permanent utilities.
  - 1. Carefully fit around service openings.
  - 2. Cut film around pipes and conduit piercing retarder, and apply pressure sensitive tape to ensure maximum barrier effectiveness.
  - 3. Construct pipe boots from vapor retarder material and pressure sensitive tape in accordance with manufacturer's instructions.
- D. Place pipes, conduits, etc. on top of vapor barrier, taking care to prevent film punctures.
- E. Repairs:
  - 1. Repair any damage to film prior to placing granular base.
  - 2. Apply patches of vapor retarder film, lapping damaged area minimum 6 inches and taping all four sides with manufacturer's tape.

### 3.04 SITE QUALITY CONTROL

- A. Contractor's Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers. Contractor shall take all other reasonable measures necessary to ensure that underslab moisture is controlled, vapor retarder is complete, intact and undamaged prior to concrete placement, water/cement ratio of slab concrete is not exceeded, fresh concrete contains no more water than required for proper placement and cement hydration, and floor slab concrete is properly cured.

END OF SECTION

**SECTION 07 60 00  
FLASHING AND SHEET METAL**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A Sections Includes:
  - 1. Flashing and counterflashing.
  - 2. Flashing at new curbs where ducts penetrate roof.
  - 3. Other new sheet metal flashing related to the above, indicated on the Drawings and not specified elsewhere.
- B Related Requirements:
  - 1. Wood Blocking and Nailers: Section 06 10 00 - Rough Carpentry.
  - 2. Cutting and Patching of Modified Bituminous Membrane Roofing: Section 07 02 52.
  - 3. Sealants: Section 07 92 00 Joint Sealants.

**1.02 REFERENCES**

- A General Requirements: Refer to Section 01 42 00.
- B Reference Standards: Comply with the following except as otherwise specified in this Project Manual.
  - 1. FM Global (FMG) Operating Standards: [www.fmglobal.com](http://www.fmglobal.com).
    - a. FMG Property Loss Prevention Data Sheet 1-28 – Wind Design, January 2012.
    - b. FMG Property Loss Prevention Data Sheet 1-29 – Roof Deck Securement and AboveDeck Roof Components, April 2016.
    - c. FMG Property Loss Prevention Data Sheet 1-49 – Perimeter Flashing, June 1985, Revised September 2000.
  - 2. National Roofing Contractors Association (NRCA):
    - a. NRCA Roofing Manual: Architectural Metal Flashing Condensation and Air Leakage Control, and Reroofing - 2014.
  - 3. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
    - a. Architectural Sheet Metal Manual, 7th Edition, 2012.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A Coordination: Coordinate work of this section with work of other sections.
  - 1. Coordinate placement of wood blockings, inserts, nailing strips, cants, etc.
  - 2. Membrane Roofing and Sheet Metal in Contact with Roofing Membrane: Coordinate with Section 07 02 52.
  - 3. Coordinate with work under Division 23 for welded duct flashing provided with HVAC work.
- B Pre-Installation Conference: Attend conference with roofing installer, roofing manufacturer's representative, General Contractor and Architect in accordance with Section 01 31 19 and Section 07 02 52.

**1.04 ACTION SUBMITTALS**

- A Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B Shop Drawings: Include:
  - 1. Overall layout of sheet metal work.
  - 2. Type, thickness, and details of sheet metal components.
  - 3. Joints, expansion joints, attachment and anchoring of sheet metal components.

**1.05 CLOSEOUT SUBMITTALS**

- A Warranty: Submit in accordance with Section 01 78 39.

**1.06 WARRANTY**

- A Warranty: Provide two year written warranty covering materials and installation for sheet metal in accordance with Section 01 78 39.
  - 1. Include that system shall be watertight and weatherproof.

2. See Warranty in Section 07 02 52.

## **PART 2 PRODUCTS**

### 2.01 DESIGN CRITERIA

- A Fire/Windstorm Classification: Comply with FMG Class 1-90.

### 2.02 SHEET METAL

- A Galvanized Iron: ASTM A653 commercial quality sheet steel, G90 commercial hot-dip galvanizing. Provide gages as indicated and specified, 20 gage minimum.
  1. Prefinishing: Coil stock coated with PPG Duranar fluoropolymer coating or equivalent finish produced with Kynar 500 resin.

### 2.03 FABRICATION

- A Field Measurements: Before fabricating sheet metal, verify shapes and dimensions of surfaces to be covered.

### 2.04 ACCESSORIES

- A Clips or Cleats: Same material and gage as sheet metal being installed.
- B Nails and Fasteners: Same metal as metal being installed or other non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.
- C Screws and Bolts: Round heads
- D Solder: ASTM B32, composition 50 percent tin and 50 percent lead. Use muriatic acid killed with zinc or soldering flux.
- E Sealant: Approved type of polyurethane; see Section 07 92 00. Roofers mastic is not acceptable.

## **PART 3 EXECUTION**

### 3.01 EXAMINATION

- A Verification of Conditions: Comply with Section 01 71 16:
  1. Layout: Verify layout of work before beginning installation.
  2. Examine surfaces to receive flashing or sheet metal. Surfaces shall be smooth, sound, clean and dry and fabric flashing in place before work is started.
- B Notification: Notify General Contractor of unsatisfactory conditions in writing with copy to Architect.
- C Acceptance: Beginning of work means acceptance of existing conditions by installer.

### 3.02 PREPARATION

- A Protective Coating: Coat contacting dissimilar metals with asphaltic compound.

### 3.03 INSTALLATION

- A Reference Standards: Unless indicated otherwise on Drawings, workmanship and details shall comply with NRCA Manual, SMACNA Architectural Sheet Metal Manual, and FM Loss Prevention Data Sheet 1-49.
- B Edges:
  1. Edges: Hem all exposed edges, 1/2-inch unless otherwise indicated.
  2. Drips: Angle bottom edges of vertical surfaces to form drips.
- C Joints: Make joints watertight and allow for expansion.
  1. Reinforce sheet metal corners as required.
  2. Reinforcement: Conceal within finished assembly.
- D Fastenings: Use concealed hook strips and fasteners. Exposed hook strips and fasteners not acceptable.
- E Expansion and Contraction:
  1. Provide for thermal expansion and contraction and building movement in completed work.
  2. Make watertight and weathertight throughout.
  3. Unless otherwise indicated, provide expansion joints at maximum of 20 feet and not more than 4 feet from corners. Seal joints with sealant in accordance with Section 07 92 00.

3.04 SHEET METAL SCHEDULE

- A Flashing and Counterflashing: As detailed of 20 gage galvanized iron.. Lock and solder joints and hem exposed edges.

**END OF SECTION**

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**SECTION 07 81 00  
APPLIED FIRE PROTECTION**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A Fireproofing of interior structural steel not exposed to damage or moisture.

1.02 RELATED REQUIREMENTS

- A Section 05 12 00 - Structural Steel Framing.
- B Section 07 84 00 - Firestopping.

1.03 REFERENCE STANDARDS

- A ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- B ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members 1993, with Editorial Revision (2015).
- C ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members 2019.
- D ASTM E760/E760M - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members 1992, with Editorial Revision (2015).
- E ASTM E937/E937M - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members 1993, with Editorial Revision (2015).
- F UL (FRD) - Fire Resistance Directory Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A Preinstallation Meeting: Convene one week before starting work of this section.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

- A Applied Fireproofing:
  - 1. GCP Applied Technologies; [\_\_\_\_]: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
  - 2. Isolatek International Corp; [\_\_\_\_]: [www.isolatek.com/#sle](http://www.isolatek.com/#sle).
  - 3. Southwest Fireproofing Products Company; [\_\_\_\_]: [www.sfrm.com/#sle](http://www.sfrm.com/#sle).

2.02 FIREPROOFING ASSEMBLIES

- A Provide fire resistance ratings for following building elements as required by local building code:
  - 1. Primary structural frame, including columns, girders, and trusses, 3 hours.

2.03 MATERIALS

- A Applied Fireproofing Material for Interior Applications, Concealed: Manufacturer's standard factory mixed material, which when combined with water is capable of providing indicated fire resistance, and complying with following requirements:
  - 1. Bond Strength: 150 pounds per square foot ( 7.2 kPa ), minimum, when tested in accordance with ASTM E736 when set and dry.
  - 2. Compressive Strength: 8.33 pounds per square inch ( 57.4 kPa ), minimum.
  - 3. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with ASTM E760.
  - 4. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937.
  - 5. Surface Burning Characteristics: Maximum flame spread index of 0 (zero) and maximum smoke developed index of 0 (zero), when tested in accordance with ASTM E84.

**PART 3 EXECUTION**

3.01 EXAMINATION

- A Verify that surfaces are ready to receive fireproofing.
- B Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.
- C Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.

- D Verify that voids and cracks in substrate have been filled.
- E Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

### 3.02 PREPARATION

- A Perform tests as recommended by fireproofing manufacturer in applications where adhesion of fireproofing to substrate is in question.
- B Remove incompatible materials that could effect bond by scraping, brushing, scrubbing, or sandblasting.
- C Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
- D Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
- E Close off and seal duct work in areas where fireproofing is being applied.

### 3.03 APPLICATION

- A Apply primer adhesive in accordance with manufacturer's instructions.
- B Apply fireproofing in uniform thickness and density as necessary to achieve required ratings.

### 3.04 CLEANING

- A Remove excess material, overspray, droppings, and debris.
- B Remove fireproofing from materials and surfaces not required to be fireproofed.

**END OF SECTION**



**SECTION 07 84 00  
FIRESTOPPING**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A Firestopping systems.
- B Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A Section 01 33 00 - Submittal Procedures
- B Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- C Section 01 77 00 - Closeout Procedures
- D Section 02 41 19 - Selective Demolition
- E Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A FCIA Firestop Manual of Practice.
- B ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops 2019.
- C ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2010a (Reapproved 2015).
- D UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

- A See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly and firestopping test or design number.
- C Product Data: Provide data on product characteristics, performance ratings and limitations.
- D Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E Certificate from authority having jurisdiction indicating approval of materials used.
- F Installer Qualification: Submit qualification statements for installing mechanics.
- G Closeout Procedures:
  - 1. Procedures: Submit the following in accordance with Section 01 77 00.
  - 2. Documentation: Compile and submit forms identifying products and technical parameters of each firestop installation performed, including manufacturer's details of the system selected for the application.

1.05 QUALITY ASSURANCE

- A Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
- B Installer Qualifications: Company specializing in performing the work of this section and:
  - 1. Trained by manufacturer.
  - 2. Verification of minimum three years documented experience installing work of this type.

1.06 MOCK-UP

- A Install one firestopping assembly representative of each fire rating design required on project.
  - 1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
  - 2. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft ( 1/3 linear m ).
- B If accepted, mock-up will represent minimum standard for the Work.
- C If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

1.07 FIELD CONDITIONS

- A Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days

after installation of materials.

B Provide ventilation in areas where solvent-cured materials are being installed.

#### 1.08 WARRANTY

A Firestop Installer shall warrant that firestopping systems used meet firestopping requirements as herein specified.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

A Firestopping Manufacturers:

1. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
2. Substitutions: See Section 01 60 00 - Product Requirements.

#### 2.02 FIRESTOPPING SYSTEMS DESIGN

A Types of firestop to be used for each condition shall be the responsibility of the installer and shall comply with all specified regulatory requirements.

B Provide a Flame (F) and Temperature (T) rating of at least one (1) hour but not less than the fire resistance rating of assembly being penetrated, as tested per ASTM E814.

C Firestop contractor shall immediately notify the Architect if the firestopping systems herein specified cannot meet the requirements of the specification.

#### 2.03 MATERIALS

A Regulatory Requirements: Firestopping materials proposed for use on this Project shall conform to both Flame (F) and Temperature (T) ratings as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests. The F rating and T rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. The fire test shall be conducted with a minimum positive pressure differential of 0.03 inches of water column.

B General Requirements for Firestopping Materials:

1. Materials shall be free of asbestos.
2. Firestop materials in exposed areas shall be compatible with specified finishes.
3. Materials shall conform to all applicable governing codes.
4. All materials shall be compatible with the material penetrating the fire assembly.
5. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
6. Provide firestop sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.
7. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.
8. Use sealants that comply with the limits for VOC content according to SCAQMD Rule #1168:
  - a. Sealants: 250 g/L.
  - b. Sealant Primers for Nonporous Substrates: 250 g/L.
  - c. Sealant Primers for Porous Substrates: 775 g/L.

C Furnish all Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

#### 2.04 FIRESTOPPING SYSTEMS

A Firestopping at Control Joints (without Penetrations): Any material meeting requirements.

1. Between Top of Fire-Rated Walls and Bottom of Slab Above: UL Design No. [\_\_\_\_], F Rating 1-1/2 hour.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A Verification of Existing Conditions: Contractor shall inspect and verify that the surface and condition of the substrates and all sleeves or blockouts furnished by others have no defects or errors that would interfere with the installation of the firestopping materials.
- B Notification: Notify Architect in writing of any defects or errors in workmanship. Do not proceed with work until all unsatisfactory conditions have been corrected.
- C Acceptance: Start of installation of firestopping shall constitute the Contractor's acceptance of surfaces and conditions of substrates, sleeves and blockouts.
- D Verify openings are ready to receive the work of this section.

### **3.02 PREPARATION**

- A Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B Remove incompatible materials that could adversely affect bond.
- C Provide primers as required which conform to Manufacturer's recommendations for various substrates and conditions.
- D Mask where necessary to protect adjoining surfaces.

### **3.03 INSTALLATION**

- A Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B Ensure that all accessories such as anchoring devices, back-up materials, clips, sleeves, supports and other materials used in the actual fire test are installed.
- C Install firestops with sufficient pressure to properly fill and seal openings to ensure an effective smoke seal.
- D Tool or trowel exposed surfaces. Remove excess firestop material promptly as work progresses and upon completion.
- E Following each installation, apply a label on or adjacent to each penetration firestop and at regular intervals along each fire-resistive joint sealant application. Label shall identify and document firestopping system installed in accordance with FCIA Firestop Manual of Practice

### **3.04 FIELD QUALITY CONTROL**

- A Firestop contractor shall examine completed firestops to ensure proper installation and full compliance with this specification.
- B All areas of work must be accessible until inspection by the applicable code authorities.
- C Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

### **3.05 CLEANING**

- A Clean adjacent surfaces of firestopping materials.
- B When finished work will be visible, clean adjacent surfaces in accordance with Manufacturer's printed instructions. Remove excess material and stains on surfaces as required.
- C If visible in the finished work, remove temporary dams after initial cure of firestops.
- D Correct staining and discoloring on adjacent surfaces.
- E Remove all debris and excess materials entirely from site and leave work in a neat and clean condition.

**END OF SECTION**

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## SECTION 07 84 13

### PENETRATION FIRESTOPPING

#### PART 1 GENERAL

##### 1.01 SUMMARY

###### A. Work Results:

1. Provide firestop systems consisting of a material, or combination of materials installed to retain the integrity of fire-resistance rated construction by maintaining an effective barrier against the spread of flame, smoke, and/or hot gases through penetrations, blank openings, construction joints, or at the gap that is created at the building perimeter of the horizontal fire resistance rated assembly and exterior wall and in or adjacent to either fire-resistance or non-fire-resistance rated barriers in accordance with the requirements of the Building Code for this Project.
  - a. Penetration firestopping systems shall be used in locations including, but not limited to, the following:
    - 1) Penetrations through fire-resistance-rated floor and roof assemblies requiring protected openings including both empty openings and openings that contain penetrating items such as cables, cable trays, conduits, pipes, ducts, etc.
    - 2) Penetrations through fire-resistance-rated wall assemblies including both empty openings and openings that contain penetrations.
    - 3) Membrane penetrations in fire-resistance-rated wall assemblies where items penetrate one side of the barrier.
2. Firestop materials in exposed areas shall be compatible with specified finishes.

###### B. Related Requirements:

1. UL Pipe Penetration system indicated on Drawings.
2. Low-Emitting Material Requirements: Section 01 61 65.
3. Joint Sealants: Section 07 92 00.
4. Mechanical and Electrical Work: Divisions 21 through 28.

##### 1.02 REFERENCES

###### A. General Requirements: Refer to Section 01 42 00.

###### B. Reference Standards: Comply with following reference standards as applicable to the Work indicated.

1. ASTM International Standard Specifications and Test Methods; [www.astm.org](http://www.astm.org):
  - a. ASTM E119-18ce1 - Standard Test Methods for Fire Tests of Building Construction and Materials.
  - b. ASTM E814-13a(2017) - Standard Test Method for Fire Tests of Penetration Firestop Systems.
  - c. ASTM E1399/E1399M-97(2017) - Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
  - d. ASTM E1966-15(2019) - Standard Test Method for Fire-Resistive Joint Systems.
  - e. ASTM E2307-15be1 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus.
2. International Accreditation Service (IAS) Standards; [www.iasonline.org](http://www.iasonline.org):
  - a. AC291 – Accreditation Criteria for Special Inspection Agencies, September 2017.
3. National Fire Protection Association (NFPA) Standards; [www.nfpa.org](http://www.nfpa.org).
  - a. NFPA 221 - Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls, 2018 edition.

4. UL Standards; [www.ul.com](http://www.ul.com):
    - a. UL 263 - Standard for Fire Tests of Building Construction and Materials, 2011 edition.
    - b. UL 1479 - Standard for Fire Tests of Penetration Firestops, 2015 edition.
    - c. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems, 2015 edition.
    - d. UL Product iQ; <https://iq.ulprospector.com>.
      - 1) Through Penetration Firestop Systems (XHEZ)
      - 2) Joint Systems (XHBN)
      - 3) Perimeter Fire Containment Systems (XHDG)
      - 4) Continuity Head-of-Wall Joint Systems (XHBO)
      - 5) Fill, Void or Cavity Materials (XHHW)
      - 6) Firestop Devices (XHJI)
      - 7) Forming Materials (XHKU)
      - 8) Wall Opening Protective Materials (CLIV)
- C. Guide References and Standard Practices: Comply with recommendations of the following except as otherwise specified in this Project Manual.
1. ASTM International Standard Practices; [www.astm.org](http://www.astm.org):
    - a. ASTM E2174-18 – Standard Practice for On-Site Inspection of Installed Firestops.
    - b. ASTM E2393-10a(2015) – Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
  2. Firestop Contractors International Association (FCIA); [www.fcia.org](http://www.fcia.org):
    - a. FCIA Firestop Manual of Practice.
  3. International Firestop Council (IFC) Standards; [www.firestop.org](http://www.firestop.org):
    - a. IFC Guidelines for Evaluating Firestop Systems Engineering Judgments.

### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  1. Inform and educate all the trades involved with the firestopping regarding firestopping requirements.
  2. Coordinate trades to ensure that all pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.
- B. A pre-construction meeting shall be scheduled and required for all parties involved in constructing fire rated assemblies prior to the start of construction.
- C. Scheduling: Schedule the Work to ensure that partitions and all other construction that conceals penetrations are not erected prior to the installation of firestop and smoke seals.

### 1.04 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Manufacturer's current product data sheets describing products to be supplied with all selected options clearly identified, basic uses, composition and materials, physical properties, precautions and limitations, applicable standards, approvals, and general installation procedures.
  1. Provide a cut sheet with VOC content highlighted.
- C. Submit system design listings, including illustrations from a nationally recognized testing agency that is applicable to each firestop configuration.
  1. Where there is no specific third party tested and classified firestop system available for particular firestop configuration from any manufacturer, the firestopping contractor shall

obtain from the firestop manufacturer an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRRA) for submittal.

#### 1.05 INFORMATIONAL SUBMITTALS

- A. Procedures: Submit for information and verification in accordance with Section 01 33 00.
- B. Certificates:
  - 1. Certify that firestop material to be asbestos free and in compliance with local regulations.
    - a. Include certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's) and are nontoxic to building occupants.
  - 2. The installer shall issue to AHJ and Owner a Certificate of Conformance confirming that the work has been carried out in accordance with Specifications.
- C. Manufacturer's Instructions:
  - 1. Submit Manufacturer's installation instructions for each type of firestop required by the Project.
    - a. Maintain one additional copy on site until completion of installation.
- D. Qualification Statements:
  - 1. Firestopping installer qualifications.

#### 1.06 CLOSEOUT SUBMITTALS

- A. Procedures: Submit the following in accordance with Section 01 78 00.
- B. Operating and Maintenance Data: Submit operation and maintenance manual for firestop systems. Compile and submit forms identifying products and technical parameters of each firestop installation performed, including manufacturer's details of the system selected for the application.

#### 1.07 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer Qualifications: Manufacturer of firestop products shall have been successfully producing and supplying these products for a period of not less than 3 years, and be able to show evidence of at least 10 projects where similar products have been installed and accepted.
  - 2. Installer Qualifications:
    - a. Engage an experienced installer who has one or more of the following qualifications:
      - 1) FM Approved in accordance with FM 4991.
      - 2) Certified by UL as a Qualified Contractor.
      - 3) Firestop Contractors International Association Contractor Member in good standing.
    - b. Licensed by the State or local authority, where applicable.
    - c. Shown to have successfully completed not less than 5 comparable scale projects.
  - 3. Special Inspection Agency Qualifications: Special Inspection agencies shall be IAS AC 291 Accredited for Firestop Systems.
    - a. Special Inspectors Credentials: Special inspectors shall pass at 80 percent, either:
      - 1) FM Firestop Exam, or
      - 2) UL/ULC Firestop Exam.
- B. Field Constructed Mockup: Prior to installing firestopping, erect mockups for each different firestop system indicated to verify selections made and to demonstrate qualities of materials and

execution. Build mockups to comply with the following requirements, using materials indicated for final installations.

1. Locate mockups on site in locations indicated or, if not indicated, as directed by Architect. Include mockup for each type of system.
2. Notify Architect in advance of the dates and times when mockups will be installed.
3. Obtain Architect and AHJ's acceptance of mockups before start of Work.
4. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging completed unit of Work. Accepted mockups in an undisturbed condition at time of Substantial Completion may become part of completed unit of Work.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. General Requirements: Comply with Section 01 60 00 and with Manufacturer's instructions and recommendations.
- B. Delivery and Acceptance Requirements: Deliver all materials in original unopened packages fully identified with Manufacturer's name, trade name and UL label.
- C. Storage and Handling Requirements: Materials shall be stored off the ground and protected from environmental conditions as required by Manufacturer.

#### 1.09 AMBIENT CONDITIONS

- A. Conform to Manufacturer's printed instructions for installation and when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.
  1. Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
  2. Ventilation: Ventilate per firestopping manufacturers' instructions or Safety Data Sheet (SDS).
- B. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.

#### 1.10 WARRANTY

- A. Firestop Installer shall warrant that firestopping systems used meet firestopping requirements as herein specified.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS AND MANUFACTURED PRODUCTS

- A. Basis of Design Manufacturer and Systems: As indicated on Drawings.
  1. Manufacturer: Specified Technologies, Inc. (STI); [www.stifirestop.com](http://www.stifirestop.com).
- B. Comparable Products: In accordance with Section 01 60 00.
  1. Comparable products by one of the following Acceptable Manufacturers may be submitted for review as an Action Submittal in accordance with Section 01 33 00:
    - a. 3M Fire Protection Products; [www.3m.com](http://www.3m.com).
    - b. A/D Fire Protection Systems; [www.adfire.com](http://www.adfire.com), division of the Carboline Company – A/D Firebarrier,
    - c. Hilti Corporation; [www.hilti.com](http://www.hilti.com) - Hilti Firestop Systems.
    - d. Nelson Thermal, Inc.; [www.nelsonfirestopping.com](http://www.nelsonfirestopping.com).



- e. The RectorSeal Corporation; [www.rectorseal.com](http://www.rectorseal.com) – Metacaulk Firestopping Products; [www.metacaulk.com](http://www.metacaulk.com).
  - f. Tremco Fire Protection Systems Group of Tremco Incorporated; [www.tremcosealants.com](http://www.tremcosealants.com), - TREMstop.
2. Submit complete data necessary for evaluation of equivalency based on specified requirements.
- C. Single Source Responsibility: Obtain firestop systems for each kind of penetration and construction condition indicated from a single primary firestop systems manufacturer, to the greatest extent possible.
- 1. Materials of different manufacture than allowed by the tested and listed system shall not be intermixed in the same firestop system or opening.
  - 2. Tested and listed, classified firestop systems are to be used. If another manufacturer has a tested and listed system, then that system shall be used prior to an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRR).

## 2.02 FIRESTOPPING SYSTEMS DESIGN

- A. General:
- 1. Where a firestop system design listing is indicated on the Drawings, provide that system.
  - 2. Where a firestop system design listing is not noted on the Drawings, types of firestop to be used for each condition shall be the responsibility of the installer, subject to review by the Architect, and shall comply with all applicable regulatory requirements.
    - a. Fire-Test-Response Characteristics: Provide firestopping System Design Listing by a testing agency in accordance with the appropriate ASTM Standard(s). A nationally recognized testing agency may be UL, ULC, FM Approvals, Intertek Testing Services, or another agency performing testing and follow-up inspection services for firestop materials that is acceptable to the authority having jurisdiction.
    - b. Systems listed by approved testing agencies may be used, providing they conform to the construction type, penetrant type, physical properties, annular space requirements and fire rating involved in each separate instance.
- B. Penetration Firestopping: Provide and install firestopping products that once installed to the tested and listed system or engineering judgment become firestop systems that are produced to resist the spread of fire, and the passage of smoke and other gases according to requirements indicated, including but not limited to the following:
- 1. Firestop all penetrations passing through fire resistance rated wall and floor assemblies and other locations as indicated on the Drawings.
  - 2. Provide and install complete penetration firestopping systems that have been tested and approved by a nationally recognized third party testing agency.
  - 3. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E814 or UL 1479, but not less than one hour or the fire-resistance rating of the construction being penetrated.
  - 4. T-Rated Through-Penetration Firestop Systems: Provide firestop systems with T ratings, in addition to F ratings, as determined per ASTM E814 or UL 1479, where indicated..
  - 5. L-Rated Through-Penetration Firestop Systems: Provide firestop systems with L ratings, in addition to F and T ratings, as determined per UL 1479, where indicated.
  - 6. W-Rated Through-Penetration Firestop Systems: Provide firestop systems with W Water Resistance ratings, in addition to F, T and L ratings, as determined per UL 1479, where indicated.
- C. For firestopping exposed to view, traffic, moisture, and physical damage, provide firestop systems for these conditions that meet conditions expected as communicated through Construction Documents.

- D Where there is no specific third party tested and listed, classified firestop system available for a particular firestop configuration, the firestopping contractor shall obtain from the firestop manufacturer, an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) for submittal.
- E. Firestop contractor shall immediately notify the Architect if the firestopping systems herein specified cannot meet the requirements of the indicated design.

## 2.03 MATERIALS

- A. Performance Requirements: Firestopping materials proposed for use on this Project shall conform to both Flame (F) and Temperature (T) ratings as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests. The F rating and T rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. The fire test shall be conducted with a minimum positive pressure differential of 0.03 inches of water column.
- B. General Requirements for Firestopping Materials:
  - 1. All materials shall be asbestos free and comply with local VOC Regulations.
  - 2. Firestop materials in exposed areas shall be compatible with specified finishes.
  - 3. Materials shall conform to all applicable governing codes.
  - 4. All materials shall be compatible with the material penetrating the fire assembly.
  - 5. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
  - 6. Provide firestop sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.
  - 7. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.
  - 8. Comply with Section 01 61 65 for specific VOC content limits for sealers and primers.:

## 2.04 ACCESSORIES

- A. Furnish all accessory materials such as fire safing batts, sleeves, sheet metal, sealants, etc. necessary to complete firestopping systems unless furnished by others.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verification of Existing Conditions:
  - 1. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping.
  - 2. Inspect and verify that all sleeves or blockouts furnished by others have no defects or errors that would interfere with the installation of the firestopping materials.
  - 3. Verify that field dimensions are as consistent with those shown on the Drawings, tested and listed, classified systems, Engineering Judgments, EFRRA's and as recommended by the manufacturer.
- B. Notification: Notify Architect in writing of any defects or errors in workmanship.

- C. Acceptance: Do not proceed with work until all unsatisfactory conditions have been corrected. Start of installation of firestopping shall constitute the Contractor's acceptance of surfaces and conditions of substrates, sleeves and blockouts.

### 3.02 PREPARATION

- A. Clean surfaces and substrates of dirt, oil, loose materials and other foreign materials that may affect the proper bond or installation of the firestops in strict accordance with Manufacturer's written instructions.
- B. Provide primers as required which conform to Manufacturer's recommendations for various substrates and conditions.
- C. Do not apply firestops to surfaces previously painted or treated with a sealer, curing compound, water repellent or other coating unless tests have been performed to ensure compatibility of materials. Remove coatings as required in compliance with Manufacturer's instructions.
- D. Mask where necessary to protect adjoining surfaces.

### 3.03 INSTALLATION, GENERAL

- A. Comply with the firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated. Install to provide a Flame (F) and Temperature (T) rating of at least one (1) hour but not less than the fire resistance rating of the assembly being penetrated.
  - 1. Equipment used shall be in accordance with firestop manufacturer's written installation instructions.
- B. Ensure that all accessories such as anchoring devices, back-up materials, clips, sleeves, supports and other materials used in the actual fire test are installed.
- C. Install firestops with sufficient pressure to properly fill and seal openings to ensure an effective seal.
- D. Tool or trowel exposed surfaces. Remove excess firestop material promptly as work progresses and upon completion.
- E. Following each installation, apply a label on or adjacent to each penetration firestop and at regular intervals along each fire-resistive joint sealant application. Label shall identify and document firestopping system installed in accordance with FCIA Firestop Manual of Practice.

### 3.04 INSTALLING PENETRATION FIRESTOPS

- A. General: Comply with the through-penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install packing/backing/forming materials and other accessories in accordance with manufacturers installation instructions, tested and listed, classified systems
- C. Install fill, void and cavity materials for through-penetration firestop systems by proven techniques as recommended by the manufacturer, tested and listed, classified system and tooled to produce the following results:
  - 1. Clean surfaces as recommended by manufacturers' written instructions.
  - 2. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

3. Install materials so they contact and adhere to substrates formed by openings and penetrating items.
4. Finish to produce smooth, uniform surfaces as recommended by manufacturer's installation instructions and tested and listed, classified system requirements.

### 3.05 SITE QUALITY CONTROL

- A. Firestop contractor shall examine completed firestops to ensure proper installation and full compliance with this specification and shall issue Certificate of Conformance.
- B. All areas of work must be accessible until inspection by the applicable code authorities.
- C. Special Inspection: Independent inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E217 and ASTM E2393.

### 3.06 ADJUSTMENT

- A. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification at no additional cost.

### 3.07 CLEANING

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses. Use methods and cleaning materials approved by manufacturers of firestopping products and or assemblies in which penetrations, openings, gaps and joints occur.
- B. When finished work will be visible, clean adjacent surfaces in accordance with Manufacturer's printed instructions. Remove excess material and stains on surfaces as required.
- C. If visible in the finished work, remove temporary dams after initial cure of firestops.
- D. Correct staining and discoloring on adjacent surfaces.
- E. Remove all debris and excess materials entirely from site and leave work in a neat and clean condition.
- F. Waste Management: If required, hazardous disposal of firestop materials shall be strictly observed as noted on the individual SDS.

### 3.08 PROTECTION

- A. Protect firestopping during and after curing period from contact with contaminating substances.

END OF SECTION

**SECTION 07 92 00  
JOINT SEALANTS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A Work Results: Providing all caulking and sealant indicated on Drawings, specified herein, and not specified under other sections. In general, seal all openings indicated on Drawings and at other locations requiring sealant to seal visually and against infiltration from air and water, or to provide acoustical isolation, including but not limited to following:
  - 1. Joints at penetrations of non-fire rated walls, decks and floors by piping and other service and equipment.
  - 2. Joints between items of equipment and other construction.
  - 3. Joints between door frames and adjacent materials.
  - 4. Open joints between similar or dissimilar materials as required to close and conceal jointing of the work.
  - 5. Joints at sound-insulated partitions.
  - 6. Flashing reglet and retainers.
  - 7. Other joints as indicated.
- B Related Requirements:
  - 1. Sealants Related to Roofing: Section 07 02 52 - Cutting And Patching Of Single Membrane Roofing.
  - 2. Firestopping: Section 07 84 00.

**1.02 ADMINISTRATIVE REQUIREMENTS**

- A Coordination:
  - 1. Coordinate installation of sealants with other construction trades.

**1.03 ACTION SUBMITTALS**

- A Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B Product Data: Submit for each material and location of application.
- C Samples: Submit for each type of sealant for color selection.

**1.04 CLOSEOUT SUBMITTALS**

- A Warranty: Submit in accordance with Section 01 78 39.

**1.05 QUALITY ASSURANCE**

- A Qualifications:
  - 1. Installer: Company specializing in sealant application. Separate subcontractor is required.
    - a. Experience: Continuously installed sealants in State of California for five years.
  - 2. Manufacturer's Technical Representative: Obtain materials only from manufacturers who will, if required, send qualified technical representative to Project site, for purpose of advising installer of proper procedures and precautions for use of materials.
- B Certifications:
  - 1. Elastomeric Sealants: Listed by SWRI on SWR Institute Validation Program Validated Products List; [www.swrionline.org](http://www.swrionline.org).

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A General Requirements: Comply with Section 01 60 00.
  - 1. Protect materials from excessive moisture in shipment, storage, and handling.
- B Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying material name and manufacturer, production date and/or product code.
- C Storage and Handling Requirements:
  - 1. Storage: Store materials in a clean, dry area not subject to extreme heat or cold in accordance with manufacturer's instructions.

2. Handling: Protect materials during handling and installation to prevent damage.

#### 1.07 AMBIENT CONDITIONS

A Do not apply exterior sealants during wet weather or when outside temperature is below 40 degrees F or apply interior sealants when inside temperature is below 60 degrees F.

#### 1.08 WARRANTY

A Warranty: Provide three year written warranty covering materials and installation for sealants in accordance with Section 01 78 39.

1. Warranty: Require installer, at no cost to Owner, to repair or replace sealants which fail to perform as airtight and watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, color retention, or general durability; or appear to deteriorate in any manner not clearly specified as inherent quality of material by submitted manufacturer's data.

### **PART 2 PRODUCTS**

#### 2.01 PRODUCT OPTIONS

A Substitution Requests: Required for all manufacturers and products not named as Acceptable or as Basis of Design, excepting types for which no manufacturer is named.

1. Submit in accordance with Section 01 25 00.

#### 2.02 MATERIALS, GENERAL

A Low-Emitting Material Requirements: Use sealants that comply with the following limits for VOC content when calculated according to SCAQMD Rule #1168:

1. Sealants: 250 g/L.

2. Sealant Primers for Nonporous Substrates: 250 g/L.

3. Sealant Primers for Porous Substrates: 775 g/L.

#### 2.03 LATEX JOINT SEALANTS

A Interior Caulk and Sealants for Under Thresholds and Non-Moving Joints: Acrylic latex, ASTM C834-10.

#### 2.04 ELASTOMERIC JOINT SEALANTS

A Acceptable Manufacturers:

1. Polyurethane Sealants:

a. BASF; [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com), Sonolastic brand.

b. Geocel Engineered Polymers.

c. Pecora Corporation; [www.pecora.com](http://www.pecora.com).

d. Sika Corporation; [www.usa.sika.com](http://www.usa.sika.com).

e. Tremco, Inc.; [www.tremcosealants.com](http://www.tremcosealants.com).

2. General Construction Sealants:

a. BASF; [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com), Sonneborn brand.

b. DAP Incorporated.

c. Pecora Corporation; [www.pecora.com](http://www.pecora.com).

d. Sika Corporation; [www.usa.sika.com](http://www.usa.sika.com).

e. Tremco, Inc.; [www.tremcosealants.com](http://www.tremcosealants.com).

3. Silicone Sealants:

a. General Electric.

b. Dow Corning; [www.dowcorning.com](http://www.dowcorning.com).

c. Pecora Corporation; [www.pecora.com](http://www.pecora.com).

d. Tremco, Inc.; [www.tremcosealants.com](http://www.tremcosealants.com).

4. Fire-Resistant Sealants:

a. BASF; [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com), Sonneborn brand.

b. DAP Incorporated.

c. Pecora Corporation; [www.pecora.com](http://www.pecora.com).

d. Sika Corporation; [www.sikaconstruction.com](http://www.sikaconstruction.com).

- e. Tremco, Inc.; [www.tremcosealants.com](http://www.tremcosealants.com).
  - B Sealant Materials and Applications:
    - 1. Exterior Vertical and Overhead Joints Not Specified Otherwise: Two-component polyurethane, ASTM C920, Type M, Grade NS, non-sag, Class 50, Use NT.
    - 2. Sealant at Lavatories, Tubs and Showers: Silicone tub sealant.
  - C Primer: As recommended by sealant manufacturer.
  - D Colors: As selected by Architect from standard colors.
- 2.05 ACOUSTICAL JOINT SEALANTS
- A Acceptable Manufacturers: Following manufacturers are acceptable for applications as specified below.
    - 1. Pecora Corporation; [www.pecora.com](http://www.pecora.com).
    - 2. Tremco, Inc.; [www.tremcosealants.com](http://www.tremcosealants.com).
    - 3. United States Gypsum Co; [www.usg.com](http://www.usg.com).
  - B Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
    - 1. Acceptable Products – Non-Fire Rated Partitions and Ceilings:
      - a. Pecora Corp. - AC-20 FTR Acoustical and Insulation Sealant. Acrylic latex type.
      - b. Pecora Corp. – AIS-919 Acoustical and Insulation Latex Sealant.
      - c. Tremco, Inc. – Tremflex 834 Siliconized Interior Acrylic Latex Sealant.
      - d. United States Gypsum Co. - SHEETROCK Brand Acoustical Sealant.
    - 2. Acceptable Products –Fire Rated Partitions and Ceilings:
      - a. Pecora Corp. - AC-20 FTR Acoustical and Insulation Sealant. Acrylic latex type.
  - C Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
    - 1. Acceptable Products:
      - a. Tremco, Inc. - Tremco Acoustical Sealant.
- 2.06 NON-RATED JOINT BACKING MATERIAL
- A Acceptable Manufacturers:
    - 1. BASF; [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com) – Sonolastic.
    - 2. Backer Rod Manufacturing Inc.; [www.backerrod.com](http://www.backerrod.com) - Denver Foam.
    - 3. Dow Chemical Company - Ethafoam.
  - B Material: Closed cell polyethylene foam.
  - C Shape: Round rod or semi-circular type.
  - D Size joint backing material for minimum 30 percent compression when inserted in joint.
- 2.07 FIRE-RATED JOINT BACKING MATERIAL
- A Acceptable Manufacturers and Products:
    - 1. Backer Rod Mfg. Inc., Denver, Colorado - Ultra Block.
  - B Size: As required for joint width.
- 2.08 BOND BREAKER TAPE
- A Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape wherever applicable.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A Verification of Conditions: Comply with Section 01 71 16:
  - 1. Inspect joints to be sealed to application of any work under this section.

- B Notification: Notify General Contractor of any joints which cannot be put into proper condition to receive sealants in writing with copy to Architect.
- C Acceptance: Beginning of work means acceptance of existing conditions by installer.

### 3.02 PREPARATION

- A Preparation of Surfaces:
  - 1. Clean surfaces in accordance with manufacturer's recommendations.
  - 2. Mask edges, if required, to protect adjoining surfaces and produce a straight finish line.
  - 3. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances that would interfere with bond of sealant.
  - 4. Do not proceed with installation of sealant over joint surfaces that have been painted, lacquered, waterproofed or treated with water repellent or other treatment of coating. Remove coating or treatment joint surfaces before installing sealant.
- B Priming: If required, prime surfaces which are to be sealed with manufacturer's recommended or standard primer, after surfaces have been prepared as specified. Before use, check primers for discoloration and dirt pick-up on adjacent surfaces. If staining occurs, after exposure, take adequate measures to prevent primer from being applied over face of adjacent porous materials by masking or other suitable measures.
- C Joint Backing:
  - 1. Joints: Depth necessary to provide for specified allowable thickness of sealant and also required backing where and as specified. Provide backing of extent and type as specified and required to provide for allowable depth of sealant.
  - 2. Back-up Materials for Sealants: Non-staining, compatible with sealant and primer. resilient nature, and as recommended by manufacturer of sealant.
    - a. Size and Shape: As required by width of joint and specified.
    - b. Do not use materials impregnated with oil, solvents or bituminous materials.
  - 3. Compress backing material minimum of 30 percent when inserted in joint. Backing material for upper portion of joints shall be round rod or semi-circular in cross-section where in contact with sealant.
- D Bond Breaker Tape: Install where indicated and as required by manufacturer's recommendations to ensure that sealants will deform properly.

### 3.03 APPLICATION

- A Joint Sealing, General:
  - 1. Apply sealants in continuous beads without open joints, voids or air pockets, using ratchet hand gun or mechanical powered gun.
  - 2. Confine sealants to joint areas with masking tapes or other precautions. Apply compounds in concealed compression joints accurately so that excess compound will not extrude from joints.
  - 3. Remove excess compound or sealant promptly as work progresses, and clean adjoining surfaces.
  - 4. In rough surfaces or joints of uneven widths, install sealant well back into joint. Recess equal to width of joint, or 3/8-inch minimum at masonry.
  - 5. Use anti-tack agent where necessary to protect freshly applied sealant from public traffic and dirt.
  - 6. Slightly recess joints to facilitate painter's line. Handtool and finish joints throughout construction.
  - 7. Comply with manufacturer's specifications and recommendations.
- B Workmanship: Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides.



1. Except as otherwise indicated, fill sealant rabbet to slightly concave surface, slightly below adjoining surfaces.
  2. Where horizontal joints are between horizontal surface and vertical surface, fill joint to form slight cove, so that joint will not trap moisture and dirt.
- C Joint Sizes: Install sealants to depths as indicated or, as recommended by sealant manufacturer but within following general limitations:
1. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to depth equal to 50 percent of joint width, but not more than 1/2-inch deep or less than 1/4inch deep.
  2. For joints sealed with non-elastomeric sealants and calking compounds. fill joints to depth in range of 75 percent to 125 percent of joint width.
- D Spillage:
1. Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either primer/sealer or sealant.
  2. Remove excess and spillage of compounds promptly as work progresses. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage. Do not damage adjoining surfaces or finishes.
- E Sinks, Lavatories and Showers: Fill joints between dissimilar materials with silicone sealant.
- 3.04 ACOUSTICAL SEALANT APPLICATION
- A Comply with manufacturer's instructions for particular conditions of installation in each case.
- B Install materials to comply with sound control requirements noted on Drawings.
- C Use a caulking-type gun, apply 1/4-inch minimum round bead of sealant (1/2-inch maximum) to seal perimeter of each sound-insulated partition.
- D Seal sound-insulated partitions on both sides where facings abut dissimilar materials; around perimeter, in the angle formed by panels and abutting dissimilar materials; at all intersections; at all panel terminations in door and window frames; and at control joint locations before attaching the control joint to the panels. Apply continuous beads of sealant around all openings formed for outlets, lights, etc. Completely butter the outside of electrical boxes.
1. Caulk ductwork penetrations.
- E Cut gypsum panels with 1/8-inch maximum relief at perimeter to receive sealant. Install before sealant skins.
- 3.05 CURING
- A Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.
- 3.06 SITE QUALITY CONTROL
- A Field Samples: Where directed by Architect, cut out and remove total of three samples consisting of undisturbed sealant and back-up material from joint. Samples shall be 6 inches in length. Reseal cut out areas with same materials.
- 3.07 CLEANING
- A Clean soiled surfaces immediately.
- B Replace any damaged material that cannot be cleaned with new material.
- 3.08 PROTECTION
- A Advise General Contractor of procedures required for protection of sealants during construction period, so that they will be without deterioration or damage (other than normal weathering) at time of acceptance.

**END OF SECTION**

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**SECTION 08 31 00  
ACCESS DOORS AND PANELS**

**PART 1 GENERAL**

1.01 SUMMARY

- A Section Includes:
  - 1. Access doors into ceiling spaces.
- B Related Requirements:
  - 1. Furnishing Access Doors as Specified in This Section for Plumbing Equipment: Division 22 Plumbing.
  - 2. Furnishing Access Doors as Specified in This Section for Mechanical Equipment: Division 23 Heating, Ventilating, and Air Conditioning (HVAC).
  - 3. Furnishing Access Doors as Specified in This Section for Electrical Equipment: Division 26 Electrical.
  - 4. Openings for Access Doors and Finishing After Installation: Applicable sections.

1.02 ACTION SUBMITTALS

- A Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B Product Data: Manufacturer's current product data sheets describing products to be supplied with all selected options clearly identified, basic uses, components, materials, physical properties, precautions and limitations, applicable standards, approvals, and general installation procedures.
- C Shop Drawings: Submit layout plan.

1.03 DELIVERY, STORAGE, AND HANDLING

- A General Requirements: Comply with Section 01 60 00.
- B Delivery and Acceptance Requirements:
  - 1. Deliver materials in original packages bearing brand name and identification of manufacturer.
- C Storage and Handling Requirements:
  - 1. Store doors, frames and panels under cover and in manner to prevent twisting.
  - 2. Doors and panels with dimples or dents will be rejected.

**PART 2 PRODUCTS**

2.01 FLUSH-MOUNTED, NON-RATED ACCESS DOORS

- A Acceptable Manufacturers and Products – Flush-Mounted, Non-Rated Access Doors for Installation in Plaster Walls and Ceilings:
  - 1. Acudor Products, Inc.; [www.acudor.com](http://www.acudor.com) - Model PS-5030.
  - 2. Industries; [www.jlindustries.com](http://www.jlindustries.com) - Model PW.
  - 3. Karp Associates, Inc.; [www.karpinc.com](http://www.karpinc.com) - Model DSC-214 PL.
  - 4. Milcor; [www.milcorinc.com](http://www.milcorinc.com) -Style K.
  - 5. Nystrom Building Products; [www.nystrom.com](http://www.nystrom.com) - Model NP.
  - 6. Williams Brothers Corporation of America; [www.wbdoors.com](http://www.wbdoors.com) - WB-PL.
  - 7. Substitution Requests: In accordance with Section 01 25 00.
- B Acceptable Manufacturers and Products - Flush-Mounted, Non-Rated Access Doors for Installation in Masonry, Tile, Concrete, or Gypsum Drywall:
  - 1. Acudor Products, Inc.; [www.acudor.com](http://www.acudor.com) - Model UF-5000.
  - 2. L. Industries; [www.jlindustries.com](http://www.jlindustries.com) - Model TM.
  - 3. Karp Associates, Inc.; [www.karpinc.com](http://www.karpinc.com).- Model DSC-214M.
  - 4. Milcor; [www.milcorinc.com](http://www.milcorinc.com) - Style M.
  - 5. Nystrom Building Products; [www.nystrom.com](http://www.nystrom.com) - Model NT.
  - 6. Williams Brothers Corporation of America; [www.wbdoors.com](http://www.wbdoors.com) – WB Series.
  - 7. Substitution Requests: In accordance with Section 01 25 00.

- C Acceptable Manufacturers and Products - Flush-Mounted, Non-Rated Ceiling Panels Located in Non-Rated Drywall Ceilings:
  1. Karp Associates, Inc. ; [www.karpinc.com](http://www.karpinc.com) – Model KDW.
  2. Substitution Requests: In accordance with Section 01 25 00.
- D Sizes: As indicated on Drawings or as required to properly service mechanical or electrical equipment.
- E Material: Stainless steel.
- F Finish:
  1. Stainless Steel: No. 4 satin finish.
- G Locking Devices: Screwdriver operated cam latch.

## 2.02 RECESSED ACCESS DOORS

- A Acceptable Manufacturers and Products – Recessed, Non-Rated Access Doors for Installation in Plaster Walls and Ceilings:
  1. Acudor Products, Inc.; [www.acudor.com](http://www.acudor.com) - Model AP-5010.
  2. Karp Associates, Inc.; [www.karpinc.com](http://www.karpinc.com) - Model DSC-210 PL.
  3. Williams Brothers Corporation of America; [www.wbdoors.com](http://www.wbdoors.com) - WB-AP.
  4. Substitution Requests: In accordance with Section 01 25 00.
- B Acceptable Manufacturers and Products - Non-Rated Access Doors, Recessed for Cladding with Gypsum Drywall Panel, for Installation in Non-Rated Gypsum Board Walls and Ceilings:
  1. Acudor Products, Inc.; [www.acudor.com](http://www.acudor.com) - Model DW-5015.
  2. Karp Associates, Inc.; [www.karpinc.com](http://www.karpinc.com) - Model RDW.
  3. Nystrom Building Products; [www.nystrom.com](http://www.nystrom.com) - Model RW.
  4. Williams Brothers Corporation of America; [www.wbdoors.com](http://www.wbdoors.com) - WB-RDW.
  5. Substitution Requests: In accordance with Section 01 25 00.
- C Acceptable Manufacturers and Products - Non-Rated Access Doors, Recessed for Installation of Acoustical Ceiling Tile:
  1. Acudor Products, Inc.; [www.acudor.com](http://www.acudor.com) - Model AT-5020.
  2. Karp Associates, Inc.; [www.karpinc.com](http://www.karpinc.com) - Model DSC-210.
  3. Milcor; [www.milcorinc.com](http://www.milcorinc.com) - Style CT.
  4. Nystrom Building Products; [www.nystrom.com](http://www.nystrom.com) - Model RA.
  5. Williams Brothers Corporation of America; [www.wbdoors.com](http://www.wbdoors.com) - WB-AT.
  6. Substitution Requests: In accordance with Section 01 25 00.
- D Acceptable Manufacturers and Products –Fire-Resistive Access Doors, Recessed for Cladding with Double Layer Gypsum Drywall Panel, for Installation in Fire-Rated Gypsum Board Floor/Ceiling Assemblies:
  1. Karp Associates, Inc.; [www.karpinc.com](http://www.karpinc.com) – Model KATR.
  2. Substitution Requests: In accordance with Section 01 25 00.
- E Sizes: As indicated on Drawings or as required to properly service mechanical or electrical equipment.
- F Material: Stainless steel.
- G Finish:
  1. Stainless Steel: No. 4 satin finish.
- H Locking Devices: Key operated cam locks.

## 2.03 FIRE-RATED ACCESS DOORS

- A Acceptable Manufacturers and Products – Flush-Mounted Fire-Rated Access Doors:
  1. Acudor Products, Inc.; [www.acudor.com](http://www.acudor.com) - Model FB-5050.
  2. Karp Associates, Inc.; [www.karpinc.com](http://www.karpinc.com) – Model KRP-150 FR.
  3. L. Industries; [www.jlindustries.com](http://www.jlindustries.com)- Model FD.
  4. Milcor; [www.milcorinc.com](http://www.milcorinc.com) – Style UFR.
  5. Nystrom Building Products; [www.nystrom.com](http://www.nystrom.com) – Model IT.

6. Williams Brothers Corporation of America; www.wbdoors.com – Model WB-FR.
  7. Substitution Requests: In accordance with Section 01 25 00.
- B Fire Rating:**
1. Provide fire rating label acceptable to local building code authority on access doors to be installed in fire rated walls and ceilings.
  2. Walls: 1-1/2 hour UL “B” label.
  3. Ceilings: Approved by Warnock Hersey International for 3 hours.
- C Sizes:** As indicated on Drawings or as required to properly service mechanical or electrical equipment, but not larger than limit for required fire rating.
- D Material:** Stainless steel.
- E Finish:**
1. Stainless Steel: No. 4 satin finish.
- F Locking Devices:** Screwdriver operated cam latch.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A Access Doors:**
1. Mechanical or Electrical Access: Access doors required for access to mechanical or electrical equipment shall be provided under Division 22, Division 23, or Division 26 and installed by the trade responsible for the material in which door is located.
  2. General Access: Furnish access door indicated on Drawings for general access to be installed by trade responsible for material in which door is located.
  3. Type:
    - a. Installation in Non-Rated Walls and Ceilings:
      - 1) In Janitor Rooms, Mechanical and Electrical Rooms, and Other Rooms Generally Accessible to Staff Personnel Only: Flush-mounted, non-rated.
      - 2) Areas and Rooms Accessible to Public: Recessed type, unless flush-mounted is specifically approved by Architect.
    - b. Installation in Fire-Rated Walls and Ceilings: Fire-rated type.
      - 1) Fire Rated Floor/Ceiling Assemblies: Fire-resistive access door with double layer of gypsum board acceptable provided finished door retains fire rating of floor/ceiling assembly.

**END OF SECTION**

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**SECTION 08 71 00  
DOOR HARDWARE**

**PART 1 GENERAL**

3.10 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

3.11 SUMMARY

- A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

- B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

- C. Related Sections:

1. Division 08 Section "Hollow Metal Doors and Frames".
2. Division 08 Section "Flush Wood Doors".
3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".

- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C – Positive Pressure Fire Tests of Door Assemblies.
3. CAN/ULC-S104 – Standard Method for Fire Tests of Door Assemblies.
4. ANSI/UL 294 – Access Control System Units.
5. ULC-S319 - Electronic Access Control Systems.

6. ULC-60839-11-1, Alarm and Electronic Security Systems - Part 11-1: Electronic Access Control Systems - System and Components Requirements.
7. CAN-ULC-S132 -- Standard Method of Tests for Emergency Exit and Emergency Fire Exit Hardware.
8. CAN-ULC-S533 - Egress Door Securing and Releasing Devices.
9. UL 305 – Panic Hardware.
10. ULC-S132, Emergency Exit and Emergency Fire Exit Hardware.
11. ULC-S533 – Egress Door Securing and Releasing Devices.
12. ANSI/UL 437- Key Locks.
13. ULC-S328, - Burglary Resistant Key Locks.

F. Registrations: All hardware specified herein shall be registered with the following agencies, as applicable:

1. Federal Communications Commission (FCC).
2. Industry Canada (IC).
3. California State Fire Marshall.
4. Florida Department of Business & Professional Regulation.
5. New York State Office of Mental Health (OMH).

### 3.12 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.





3.13 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
  - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
  - 1. Function of building, purpose of each area and degree of security required.
  - 2. Plans for existing and future key system expansion.
  - 3. Requirements for key control storage and software.
  - 4. Installation of permanent keys, cylinder cores and software.
  - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
  - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware

(including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  3. Review sequence of operation narratives for each unique access controlled opening.
  4. Review and finalize construction schedule and verify availability of materials.
  5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

### 3.14 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

### 3.15 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.
- D. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

3.16 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. Ten years for mortise locks and latches.
  - 2. Five years for exit hardware.
  - 3. Five years for manual overhead door closer bodies.
  - 4. Ten years for manual overhead door closer bodies.
  - 5. Fifteen years for manual overhead door closer bodies.
  - 6. Twenty five years for manual overhead door closer bodies.
  - 7. Five years for motorized electric latch retraction exit devices.
  - 8. Two years for electromechanical door hardware.

3.17 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

**PART 4 - PRODUCTS**

4.10 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

#### 4.11 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
  1. Quantity: Provide the following hinge quantity:
    - a. Two Hinges: For doors with heights up to 60 inches.
    - b. Three Hinges: For doors with heights 61 to 90 inches.
    - c. Four Hinges: For doors with heights 91 to 120 inches.
    - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
  2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
    - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
  3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
  4. Hinge Options: Comply with the following:
    - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
  5. Manufacturers:
    - a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - MacPro Series.
    - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
    - c. Stanley Hardware (ST).

- B. Pivots: ANSI/BHMA A156.4, Grade 1, certified. Space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door. Pivots to be UL listed for windstorm where applicable.

1. Manufacturers:

- a. Architectural Builders Hardware (AH).
- b. Rixson Door Controls (RF).

#### 4.12 POWER TRANSFER DEVICES

- A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

- a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - QC (# wires) Option.
- b. Stanley Hardware (ST) – C Option.

- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

- a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
- b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

- a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) – QC-C Series.
- b. Stanley Hardware (ST) – WH Series.

#### 4.13 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
  2. Furnish dust proof strikes for bottom bolts.
  3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
  4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
  5. Manufacturers:
    - a. Ives (IV).
    - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
    - c. Trimco (TC).
- B. Coordinators: ANSI/BHMA A156.3 certified door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
1. Manufacturers:
    - a. Ives (IV).
    - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
    - c. Trimco (TC).

#### 4.14 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinders: Original manufacturer cylinders complying with the following:
  1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
  2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
  4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  5. Keyway: Match Facility Restricted Keyway.
- D. Interchangeable Cores: Provide small format interchangeable cores as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.
- E. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- F. High Security Cylinders: ANSI/BHMA A156.5, Grade 1 High security cylinder tested to UL437, including both pick and drill resistance. Pick resistance to incorporate two or more independent locking mechanisms including a pin tumbler device with six top pin chambers, mushroom-shaped driver pins, and coded sidebar locking mechanism operated independently from the six

top pin tumbler device. Drill resistance to incorporate cylinder housing with fixed case-hardened inserts protecting the pin tumbler shear line, cylinder plugs with case-hardened inserts protecting both the pin tumbler shear line and the side bar, mushroom-shaped stainless steel driver pins, and stainless steel side pins. Cylinders to be factory keyed.

1. New high security key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
2. Manufacturers:
  - a. ASSA (AA) – V10 Series.
  - b. ASSA (AA) – Maximum+.
  - c. Corbin Russwin (RU) – Access 3 AHS.
  - d. Corbin Russwin (RU) – Pyramid PHS.
  - e. dormakaba Best (BE) – Best UL.
  - f. Marks (MX) – Hi-Security.
  - g. Medeco (MC) – Medeco 3.
  - h. Sargent (SA) – Degree DG3.
  - i. Sargent (SA) – KESO UL.
  - j. Sargent (SA) – Signature UL.
  - k. Schlage (SC) – Everest 29.
  - l. Schlage (SC) – UL Primus Everest XP.
  - m. Yale Commercial (YA) – U5000.
  - n. No Substitution.

G. Security Cylinders: ANSI/BHMA A156.5, Grade 1, patterned security cylinders and keys able to be used together under the same facility master or grandmaster key system. Cylinders to be factory keyed.

1. New security key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
2. Manufacturers:
  - a. Corbin Russwin (RU) – Access 3 AS.
  - b. Corbin Russwin (RU) – Pyramid PS.
  - c. dormakaba Best (BE) – SKC.
  - d. Sargent (SA) – Degree DG2.
  - e. Sargent (SA) – KESO.
  - f. Sargent (SA) – Signature.
  - g. Schlage (SC) – Primus Everest.
  - h. Yale Commercial (YA) – 5000.
  - i. No Substitution.

H. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified patented cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.



1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
2. Manufacturers:
  - a. Corbin Russwin (RU) – Access 3 AP.
  - b. Corbin Russwin (RU) – Pyramid.
  - c. dormakaba Best (BE) – 1CK Best Peaks.
  - d. dormakaba Best (BE) – CORMAX.
  - e. dormakaba Best (BE) – MX8.
  - f. Medeco (MC) – X4.
  - g. Sargent (SA) – Degree DG1.
  - h. Sargent (SA) – XC.
  - i. Schlage (SC) – Everest D.
  - j. Schlage (SC) – Everest 29 SL.
  - k. Yale Commercial (YA) – Keymark X4.
  - l. No Substitution.

I. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

J. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

K. Construction Keying: Provide construction master keyed cylinders.

L. Construction Keying: Provide temporary keyed construction cores.

M. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

#### 4.15 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

- P. Electronic Key Management System: Provide an electronic key control system with Stand-alone Plug and Play features including advanced RFID technology. Touchscreen interface with PIN access for keys individually locked in place. Minimum 1,000 system users and 21 iFobs for locking receptors. System shall have a minimum 250,000 audit events screen displayed or ability to be exported via USB port.

- 1. Manufacturers:

#### 4.16 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

- 1. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.13 requirements to 10 million cycles or greater.
  - 2. Where specified, provide status indicators with highly reflective color and wording for "locked/unlocked" or "vacant/occupied" with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status. Indicator window size to be a minimum of 2.1" x 0.6" with a curved design allowing a 180 degree viewing angle with protective covering to prevent tampering.
  - 3. Provide mortise lock bodies functionally compatible with a rose-less lever trim option.
  - 4. Manufacturers:
    - a. Corbin Russwin Hardware (RU) – ML2000 Series.

#### 4.17 AUXILIARY LOCKS

- A. Sliding Door Privacy Lock: Provide field reversible units with emergency release key and ADA options as specified.

- 1. Manufacturers:
    - a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

#### 4.18 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

- 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

#### 4.19 ELECTRIC STRIKES

- A. Standard Electric Strikes: Electric strikes tested to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 1 million operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified. Where specified provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Manufacturers:

- a. Folger Adam (FO) - 700 Series.
- b. Folger Adam (FO) - 742 Series.
- c. HES (HS) - 1006 Series.
- d. HES (HS) - 1500/1600 Series.
- e. HES (HS) - 4500 Series.
- f. Locknetics (LO) - MDS100 Series.
- g. Rutherford Controls (RC) - F2100/F2300 Series.
- h. Security Door Controls (SD) - 55 Series.
- i. Trine Access Technology (TR) - 4100 Series.
- j. Von Duprin (VD) - 6200/6400 Series.

- B. Standard Electric Strikes: Electric strikes tested to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability with field selectable fail-secure/fail-safe. Where specified provide latchbolt monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Manufacturers:

- a. Adams Rite (AD) - 7100 Series.
- b. HES (HS) - 5000/5200 Series.
- c. Locknetics (LO) - CS450/CS750 Series.
- d. Rutherford Controls (RC) - L6500/S6500/7100/7300 Series.
- e. Security Door Controls (SD) - 25/45 Series.
- f. Trine Access Technology (TR) - 2000/2600/4200 Series.
- g. Von Duprin (VD) - 4200/5100 Series.

- C. Standard Electric Strikes: Electric strikes tested to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings that install with no cutting of the frame required. Strikes shall be tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified with latchbolt monitoring as indicated.
1. Manufacturers:
    - a. HES (HS) - 8000/8300/8500 Series.
    - b. Locknetics (LO) - NC450 Series.
- D. Heavy-Duty Electric Strikes: Electric strikes tested to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings designed to accommodate pre-load on fail secure models. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability with field selectable fail-secure/fail-safe and where specified provide latchbolt monitoring.
1. Manufacturers:
    - a. Adams Rite (AD) - 7400 Series.
    - b. HES (HS) - 7000/7500 Series.
- E. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes tested to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.
1. Manufacturers:
    - a. Adams Rite (AD) - 74 Series.
    - b. Adams Rite (AD) - 7800 Series.
    - c. Folger Adam (FO) - 310-4 Series.
    - d. HES (HS) - 9400/9500/9600/9700/9800 Series.
    - e. Locknetics (LO) - RS200/RS300 Series.
    - f. Rutherford Controls (RC) - 0162/F0162/0163/0563 Series.
    - g. Von Duprin (VD) - VD3146/6200/6300 Series.
- F. Unlatch Electric Strikes: Electric strikes with 1500 pounds of holding force with no cutting or altering of the jamb required to fit a standard ANSI 4-7/8" strike cutout. Strikes shall be motorized without solenoids that release under preload and maintain the deadlatch function at all times.
1. Manufacturers:
    - a. HES (HS) - UNL/MUNL Series.

- G. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

#### 4.20 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
5. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
6. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.
7. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.
8. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
  - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
  - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
9. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

10. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
  11. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  12. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  13. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Manufacturers:
    - a. Arrow (AW) – 3700/3800/3900, 4800/4900 Series.
    - b. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.

#### 4.21 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
  2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
  3. Cycle Testing: Provide closers which have surpassed 15 million cycles.
  4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
  5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
  7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
  8. Tornado Resistance Compliance: Door closers to be U.L. listed for windstorm assemblies where applicable. Provide the appropriate tornado resistant products that have been independent third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.

- B. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Manufacturers:

- a. Arrow (AW) – DC500 Series.
- b. dormakaba Stanley (ST) – CLD-4551 Series.
- c. Falcon Hardware (FA) – SC70 Series.
- d. LCN Closers (LC) – 1450 Series.
- e. Norton Door Controls (NO) – 8500 Series.
- f. Norton Door Controls (NO) – 410 Series.
- g. Yale Commercial (YA) – 5800 Series.

#### 4.22 SURFACE MOUNTED CLOSER HOLDERS

- A. Electromagnetic Door Holders: Certified ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate 12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.

1. Manufacturers:

- a. Rixson (RF) - 980/990 Series.
- b. Sargent Manufacturing (SA) - 1560 Series.

#### 4.23 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
  - a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
  - a. Ives (IV).
  - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
  - c. Trimco (TC).

#### 4.24 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
  1. Manufacturers:
    - a. Ives (IV).
    - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
    - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
  1. Manufacturers:
    - a. Rixson Door Controls (RF).

#### 4.25 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
  1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.



- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
  - 1. National Guard Products (NG).
  - 2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
  - 3. Zero (ZE).

#### 4.26 OPENING LABELS

- A. Provide 1"W x 2"H gloss polyester label imprinted with door mark and QR-type code readable via IR and visible light scan. QR code links to a security credential protected site displaying the installed door opening information. Label constructed with a high-performance, permanent acrylic adhesive resistant to chemicals, smear and scratch, and repeated freeze and thaw cycles. Face stock of label to be white or clear coated, 2.0 mil thickness with tensile strength meeting or exceeding 18,000 psi.
  - 1. Approved Manufacturer: Openings Studio™ Smart Tags (AA).

#### 4.27 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

#### 4.28 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## **PART 5 - EXECUTION**

### 5.10 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 5.11 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

### 5.12 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
  - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

#### 5.13 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures" and "Cash Allowances". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
  - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.
  - 2. Submit documentation of incomplete items in the following formats:
    - a. PDF electronic file.
    - b. Electronic formatted file integrated with the Openings Studio™ door opening management software platform.

#### 5.14 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

#### 5.15 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

#### 5.16 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

5.17 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. RF - Rixson
3. RO - Rockwood
4. SA - SARGENT
5. RU - Corbin Russwin
6. RS - RITE Slide
7. OT - Other
8. FO - Folger Adam
9. BM - Besam
10. PE - Pemko
11. NO - Norton
12. SU - Securitron

PART 1 - PRODUCTS

1.1 SCHEDULED DOOR HARDWARE

A. Refer to "PART 3 – EXECUTION" for required specification sections.

PART 2 -

1. MK - McKinney
2. RF - Rixson
3. RO - Rockwood
4. SA - SARGENT
5. RU - Corbin Russwin
6. RS - RITE Slide
7. OT - Other
8. FO - Folger Adam
9. BM - Besam
10. PE - Pemko
11. NO - Norton
12. SU - Securitron

**Hardware Sets**

**Set: 1.0**

Doors: 100A

1 Intermediate Pivot	M19	613E	RF
1 Pivot Set	147	613E	RF
1 Rim Exit Device, Nightlatch	ED4200 K157ET x LC M110 MELR 5CH 525	613E	RU ⚡
1 Cylinder	Match Facility Standard		OT
1 Pull	RM3131-12 Mtg-Type 12HD	US10BE	RO
1 Auto Operator	SW200i with hi - low actuators	689	BM ⚡
1 Door Stop	466-RKW	Black	RO
1 Threshold	271D		PE
1 Sweep	315DN		PE

Notes: Seals by Frame MFG

Door normally closed and locked with free egress at all times. From outside valid credential will momentarily unlatch door and trigger operator to open door. From inside push pad always active to open door. Doors remain locked with loss of power.

**Set: 2.0**

Doors: 201A

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Fire Rated Rim Exit, Classroom	ED5200A N955ET M110 5CH 525 LC	630	RU
1 Cylinder	Match Facility Standard		OT
1 Surface Closer	DC6200	689	RU
1 Kick Plate	K1050 10" BEV CSK	US32D	RO
1 Wall Stop	406	US32D	RO
1 Gasketing	S88BL		PE

**Set: 3.0**

Description: Not Used

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Passage Latch	ML2010 NSF	630	RU
1 Surface Closer	DC6200	689	RU
1 Kick Plate	K1050 10" BEV CSK	US32D	RO
1 Electromagnetic Holder	998M	689	RF ⚡
1 Gasketing	S88BL		PE

Notes: Connect magnetic hold open to fire alarm to release upon alarm.

**Set: 4.0**

Doors: 107A

5 Hinge, Full Mortise	TA2314	US32D	MK
1 Electric Hinge	TA2714 QC	US26D	MK ⚡
1 Auto Flush Bolt top bolt only - Wood door	2940	US26D	RO
1 Storeroom Lock	ML2057 NSF LC	630	RU
1 Cylinder	Match Facility Standard		OT
1 Electric Strike (fail secure)	310-2	630	FO ⚡
2 Auto Operator	SW200i with wave to open switches	689	BM ⚡
1 Astragal	357C		PE
2 Silencer	608-RKW		RO
1 Frame Harness	QC-C1500		MK ⚡

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Tri-City Medical Center  
SA Project No. 01907.01

Door Hardware  
08 71 00 - 24  
OSHPD#: S200813-37-00



Delta 6 DESIGN CHANGES 4/10/2021

Doors: 108A

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Passage Latch	ML2010 NSF	630	RU
1 Kick Plate	K1050 10" BEV CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

**Set: 8.0**

Doors: 107C

6 Hinge, Full Mortise	TA2314	US32D	MK
1 Auto Flush Bolt top bolt only - Wood door	2940	US26D	RO
1 Classroom Lock	ML2055 NSF LC	630	RU
1 Cylinder	Match Facility Standard		OT
1 Coordinator	2600 x FB x Mtg Brkts	US28	RO
1 Concealed OH Stop, HD	1-X36	630	RF
1 Wall Stop	406	US32D	RO
1 Astragal	357C		PE
2 Silencer	608-RKW		RO

**Set: 9.0**

Doors: 102A

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Classroom Lock	ML2055 NSF LC	630	RU
1 Cylinder	Match Facility Standard		OT
1 Surface Closer	DC6200	689	RU
1 Kick Plate	K1050 10" BEV CSK	US32D	RO
1 Wall Stop	406	US32D	RO
3 Silencer	608-RKW		RO

Notes: RF Shield by door mfg

**Set: 10.0**

Doors: 101A, 108B, 113A

3 Hinge, Full Mortise	TA2314	US32D	MK
1 Classroom Lock	ML2055 NSF LC	630	RU
1 Cylinder	Match Facility Standard		OT
1 Surface Closer	DC6200	689	RU

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Tri-City Medical Center  
SA Project No. 01907.01

Door Hardware  
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OSHPD#: S200813-37-00



Delta 6 DESIGN CHANGES 4/10/2021

1 Kick Plate	K1050 10" BEV CSK	US32D	RO
1 Wall Stop	406	US32D	RO
1 Gasketing	S88BL		PE

**Set: 11.0**

Doors: 105A, 109A

1 Pivot	EP-5J	US26D	MK
1 Privacy Lock	ML2030 NSF M34 M19V	630	RU
1 Kick Plate	K1050 10" BEV CSK	US32D	RO
1 Mop Plate	K1050 6" high CSK BEV	US32D	RO
1 Wall Stop	406	US32D	RO
1 Combination Stop/Strike	CSS-9x5-3/4-CH	US26D	MK

**Set: 12.0**

Doors: 110A

1 Privacy Lock	S9540	630	RS
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**Set: 13.0**

Doors: 108C

1 Entry Lock	S9550	630	RS
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END OF SECTION 087100

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## SECTION 09 05 61

### COMMON WORK RESULTS FOR FLOORING PREPARATION

#### PART 1 GENERAL

##### 1.01 SUMMARY

###### A. Work Results:

1. Preparation of concrete slabs to receive finish flooring under flooring sections of Division 09, and testing procedures to verify conditions of concrete subfloor are suitable to receive finish flooring.
  - a. Types of Concrete Slabs Included, Where They Occur:
    - 1) Existing concrete slab-on-grade floor slabs to receive new flooring.
  - b. Concrete slabs to receive finish flooring of the following types are included, where they occur:
    - 1) Resilient Sheet Flooring: Section 09 65 16.
  - c. Concrete slabs to receive the following finishes are excluded, where they occur:
    - 1) Sealed concrete, without other finish.
    - 2) Ceramic, porcelain, glass, and quarry tile installed over cementitious or epoxy-based setting materials directly to concrete.
  - d. Testing Included:
    - 1) Moisture vapor emission.
    - 2) Relative humidity.
    - 3) Alkalinity.
    - 4) Bond testing for all interior floor slabs to receive adhered floor finish materials.
2. Concrete slab drying procedures.
3. Concrete slab leveling.
4. Concrete slab cleaning.
5. Vapor emission control treatment, if required.

###### B. Related Requirements:

1. General Notes on Interior Design Drawings.
2. Low-Emitting Material Requirements: Section 01 61 65.
3. Quality Control and Testing: Section 01 45 00 Quality Control.
4. Concrete Floor Slabs Patching: Section 03 30 15 Miscellaneous Cast-In-Place Concrete.
5. Preparation of Subfloors to Receive Ceramic Tile: Section 09 01 30.61 Tile Repair.

##### 1.02 REFERENCES

###### A. General Requirements: Refer to Section 01 42 00.

###### B. Reference Standards: Comply with following except as modified by supplementary requirements of this Project Specification.

1. ASTM International Standard Specifications and Test Methods; [www.astm.org](http://www.astm.org):
  - a. ASTM F1869-16a - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
  - b. ASTM F2170-19a - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

- C. Guide References and Standard Practices: Comply with recommendations of the following except as otherwise specified in this Project Manual.
  - 1. American National Standards Institute (ANSI); [www.ansi.org](http://www.ansi.org).
    - a. ANSI A108 - American National Standard Specifications for Installation of Ceramic Tile:
      - 1) A108.01 – General Requirements: Subsurfaces and Preparations by Other Trades – 2016.
  - 2. ASTM International Standard Practices; [www.astm.org](http://www.astm.org):
    - a. ASTM F710-19e1 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
    - b. ASTM F2678-16 – Standard Practice for Preparing Panel Underlayments, Thick Poured Gypsum Concrete Underlayments, Thick Poured Lightweight Cellular Concrete Underlayments, and Concrete Subfloors with Underlayment Patching Compounds to Receive Resilient Flooring.

### 1.03 SCHEDULING

- A. Comply with other requirements specific to each flooring type as specified in Division 09 finish flooring specification sections, and with each finish flooring manufacturer's written instructions regarding scheduling limitations, coordination with other trades, and conditions necessary before flooring may be installed.

### 1.04 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data:
  - 1. Vapor Emission Control Treatment: Include data documenting compliance with product performance requirements specified in this section.

### 1.05 INFORMATIONAL SUBMITTALS

- A. Procedures: Submit for information and verification in accordance with Section 01 33 00.
- B. Manufacturer's Installation/Application Instructions: Submit for following products for approval by Architect only if products are required to be utilized based on moisture testing results:
  - 1. Maintain one copy on site until completion of product application.

### 1.06 CLOSEOUT SUBMITTALS

- A. Procedures: Submit in accordance with Section 01 78 00:
- B. Vapor Emission Control Treatment Warranty: If vapor emission control treatment is required, submit Manufacturer's warranty.

### 1.07 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Vapor Emission Control Treatment Installer: Vapor Emission Control Treatment Manufacturer employed or certified personnel.

### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. General Requirements: Comply with Section 01 60 00.

- B. Delivery and Acceptance Requirements: Deliver products in original unopened manufacturer's containers with labels intact.
- C. Storage and Handling Requirements: Comply with Manufacturer's printed instructions.

#### 1.09 WARRANTY

- A. Finish Flooring Manufacturers' Warranties: In addition to flooring preparation and testing specified under this Section, comply with additional requirements, if any, specified by finish flooring manufacturers as warranty conditions.
- B. Vapor Emission Treatment Performance and Workmanship Warranty: If vapor emission treatment of floor slabs is required to comply with performance requirements of this section, Manufacturer shall provide, in accordance with Section 01 78 00, an installation workmanship and material performance warranty for a period of ten (10) full years from date of application. In the event of treatment system failure by concrete moisture and alkalinity over slab surfaces, joints or cracks, Manufacturer shall provide materials and installation labor for repair or replacement of damaged flooring system at no charge to the Owner. Warranty shall cover repair or replacement of the flooring system, adhesives, patching compounds, and treatment system.
  - 1. Underwriter Coverage of Manufacturer's Warranty: Provide Owner with a warranty underwritten by a product liability insurance carrier, with a maximum "A" rating from Best or equivalent rating system, in the amount of \$5 million per occurrence, and naming Owner, Architect and General Contractor as co-insured.

### PART 2 PRODUCTS

#### 2.01 REGULATORY REQUIREMENTS

- A. All vapor emission control treatment products shall be certified to be VOC compliant with all applicable federal, state and local regulations.

#### 2.02 VAPOR EMISSION CONTROL TREATMENT SYSTEMS

- A. Acceptable Manufacturers and Systems:
  - 1. Ardex Engineered Cements; [www.ardex.com](http://www.ardex.com). – MC Moisture Control System.
    - a. Primer: Ardex P-MC.
    - b. Sealer: Ardex S-MC.
  - 2. Floor Seal Technology, Inc.; [www.floorseal.com](http://www.floorseal.com) – MES 100 vapor emission control system utilizing all of the following components, unless otherwise recommended by system manufacturer based on Project conditions encountered:
    - a. MES Penetrant water-based modified resinous epoxy.
    - b. MES Coating water-based modified resinous epoxy.
    - c. MES Membrane water-based modified resinous epoxy.
  - 3. Koester American Corporation, 757/425-1206; [www.koesterusa.com](http://www.koesterusa.com). - VAP I 2000 System, utilizing all of the following components, unless otherwise recommended by system manufacturer based on Project conditions encountered:
    - a. VAP I Primer, water-based primer/curing agent containing epoxy resins.
    - b. VAP I 2000, 100 percent solids modified resinous epoxy.
  - 4. Synthetics International, 866/646-0356; [www.syntheticsintl.com](http://www.syntheticsintl.com) - Synthetic30, utilizing the following materials:
    - a. Non-porous primer
    - b. Synthetic30 penetrating waterborne polymer.

- B. Performance Requirements:
  - 1. Application of vapor emission treatment system to concrete floor slabs that initially fail to meet vapor emission performance requirements specified in Article 2.02 "Performance" shall reduce vapor emission to within specified limits.
  - 2. Treatment system shall be certified by independent testing agency to meet the following:
    - a. Water Vapor Transmission Rate: Application shall yield a maximum emission rate of 2.0 lbs/ 24 hours/ 1000 ft<sup>2</sup> when tested in accordance with ASTM E96.
    - b. Alkali Resistance: Insensitive for long term to pH exposures up to 14 when tested in accordance with ASTM D1308.
    - c. Pull-Off Concrete Adhesion: Exceeding 500 psi or reaching concrete cohesive failure when tested in accordance with ASTM D4541.
- C. Vapor Emission Control Treatment Materials:
  - 1. VOC Content: Not greater than 65 g/liter in accordance with EPA Method 24 or SCAQMD 1168.
- D. Cementitious Underlayment: Required over treated slab.
  - 1. Acceptable Manufacturers and Products: Ardex K-15 Self-Leveling Underlayment Concrete or alternate product recommended by treatment system manufacturer and compatible with treatment system materials.

## 2.03 ALKALINITY NEUTRALIZER

- A. Neutralizer for Treating Concrete Floor Slabs with Measured pH Higher Than That Acceptable to Flooring Manufacturer: Use only materials accepted by flooring manufacturer to treat floors to receive flooring manufacturer's products. Obtain manufacturer's written acceptance of proposed treatments.
- B. Available Manufacturers and Products:
  - 1. Foundation Armor; [www.foundatinarmor.com](http://www.foundatinarmor.com) – Armor PH Balance.
- C. Prohibited Materials: Acids that, if applied, are detrimental to cement and strength of concrete and/or to flooring adhesives or flooring materials shall not be used.
  - 1. Vinegar shall not be used.
  - 2. Muriatic acid shall not be used.
- D. Low-Emitting Material Requirements: See Section 01 61 65.

## PART 3 EXECUTION

### 3.01 TESTING, GENERAL

- A. Testing Agency: Vapor emission and alkalinity testing will be conducted by an approved testing agency in accordance with ASTM F710 and Section 01 45 00.
  - 1. Cooperate fully with those making tests.
  - 2. Test Reports:
    - a. Distribution: Reports of tests shall be distributed by independent testing laboratory in accordance with Section 01 45 00. The General Contractor shall make copies and distribute moisture and bond test reports to each flooring contractor.
    - b. Include testing agency name and primary contact of test performer.
    - c. Include type of testing equipment employed.
    - d. Include floor plan with clearly marked test locations.
    - e. Include written description of test placement quality control practices.

- f. Vapor Emission Tests:
    - 1). Include estimated building temperature at test location.
    - 2) Include test location, starting date, starting time, beginning weight, stopping date, time and ending weight.
    - 3) Indicate computed pounds of emission, including equations.
  - g. Alkalinity Tests: Indicate measured pH test results.
  - h. Relative Humidity Tests: Report testing results in accordance with ASTM F2170.
- B. Testing by Flooring Contractors: If testing by flooring contractor is required by flooring manufacturer as a condition precedent to providing flooring warranty, such testing shall be performed as required by manufacturer, and shall be in addition to testing by the Owner's agency as specified herein.

### 3.02 SLAB MOISTURE TESTING

- A. General: Before beginning installation of finish flooring materials and floor coatings, concrete floor slabs to receive adhesive-applied floor finish materials, fluid-applied flooring, floor coatings, wood flooring, or that will be in contact with moisture-sensitive equipment or products, shall be tested to measure their moisture vapor emission rate (MVER) and internal relative humidity in order to evaluate the slabs' suitability to receive the proposed flooring installation.
- B. Calcium Chloride Tests: Surfaces of concrete floor slabs shall be tested to measure their moisture vapor emission rate (MVER) using the anhydrous calcium chloride testing procedure in accordance with ASTM F1869.
1. Acceptable Test Results: Vapor emission tests will be considered satisfactory if measured moisture emission does not exceed 3 pounds per 1000 square feet over 24 hours.
    - a. Resilient Flooring: Vapor emission tests will be considered satisfactory if measured moisture emission does not exceed 3 pounds per 1000 square feet over 24 hours.
    - b. If flooring manufacturer's warranty stipulates a stricter standard, vapor emission test results will be required to meet manufacturer's standard before that flooring may be installed in the failing area of slab.
    - c. Areas to Receive Finish Flooring Materials Warranted for Vapor Emission Greater Than That Specified: Upon submission of sample warranty documenting flooring manufacturer's higher allowable vapor emission limit, such higher limit may be substituted for specified 5 pound limit, subject to Architect's approval.
  2. Slabs failing moisture emission test shall receive additional drying time, or, at Owner's option, may be required to receive vapor emission control treatment as specified herein, until further testing demonstrates slab achieves specified moisture vapor emission rate limit.
  3. If, at any given test location, slab passes calcium chloride test, but fails alkalinity (pH) test, and no reasonable explanation is evident for pH test failure other than slab moisture, calcium chloride test shall be repeated at that location to verify original test was not a false positive.
- C. Relative Humidity Tests: Interiors of concrete floor slabs shall be tested using the in situ relative humidity testing procedure specified by ASTM F2170.
1. Acceptable Test Results: Relative humidity shall be measured at 75 percent or less.
    - a. If flooring manufacturer's warranty stipulates a stricter standard, relative humidity test results will be required to meet manufacturer's standard before that flooring may be installed in the failing area of slab.
    - b. Areas to Receive Finish Flooring Materials Warranted for Relative Humidity Greater Than 75 Percent: Upon submission of sample warranty documenting flooring manufacturer's higher allowable relative humidity limit, such higher limit may be substituted for specified 75 percent limit, subject to Architect's approval.
  2. Slabs failing relative humidity test shall receive additional drying time, or, at Owner's option, may be required to receive vapor emission control treatment as specified herein, until further testing demonstrates slab achieves specified moisture vapor emission rate limit.

- D. Test Scheduling: No later than two weeks prior to scheduled finish flooring installation, perform final moisture testing, both calcium chloride and relative humidity tests. Testing shall be a minimum of 3 tests for the first 1,000 square feet of floor area, and one test for each additional 1,000 square feet. Include moisture tests around room perimeter, at columns and where moisture may be evident.

### 3.03 SLAB ALKALINITY TESTING

- A. General: After curing and before beginning installation of finish flooring materials and floor coatings, concrete floor slabs to receive adhesive-applied floor finish materials, fluid-applied flooring, floor coatings, wood flooring, or that will be in contact with moisture-sensitive equipment or products, shall be tested to measure their surface pH in accordance with ASTM F710.
- B. Testing Methods:
  - 1. pH Paper Method: Use wide range pH paper, its associated pH chart, and distilled or deionized water. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for 60 plus-or-minus 5 seconds, then dip the pH paper into the water. Remove immediately, and compare to chart to determine pH reading.
  - 2. Other pH testing methods such as pH pencils or pH meters, or both, are available and may be used to measure pH.
- C. Testing Scheduling and Locations: Test at same time, rate and near locations of calcium chloride tests, except as follows.
  - 1. Do not test slabs for pH that have been recently bead blasted or otherwise abraded to remove near surface layer. Allow such slabs to remain exposed to air at least 14 days before testing surface for pH.
- D. Acceptable Test Results: Slab alkalinity will be acceptable if measured pH is less than 9.0.
- E. Slabs failing alkalinity test shall receive vapor emission control treatment or pH neutralization treatment as specified herein until further testing demonstrates slab meets this alkalinity limitation.

### 3.04 BOND TESTING FOR RESILIENT FLOORING

- A. General: After curing and cleaning of slab surfaces, and before beginning application of resilient flooring adhesive, resilient flooring contractor(s) shall test adhesive bonding to slab.
- B. Testing Procedures:
  - 1. Using the flooring material and the proposed adhesives, install 3 foot by 3 foot panels spaced approximately 50 feet apart throughout the subfloor area. Select areas next to walls, columns or other light traffic areas.
  - 2. Tape edges of panels to prevent edge drying of adhesive.
  - 3. After 72 hours, check panels in presence of Architect and General Contractor's Superintendent.
- C. Acceptable Test Results: Test will be considered satisfactory if flooring material is found, in the opinion of the Architect, to be securely bonded such that an unusual amount of force is required to lift it from the subfloor.
- D. Slabs failing bond test shall receive additional treatment as specified herein until further testing demonstrates satisfactory bond. Additional treatment may consist of mechanical or chemical cleaning to remove contaminants or vapor emission control treatment of excessively moist concrete subfloor.



### 3.05 PATCHING AND LEVELING

- A. Verification of Conditions: Examine substrate for unevenness which would prevent execution and quality of flooring as specified. Report unsatisfactory conditions to the General Contractor with copy to Architect.
  - 1. Examine subfloors prior to installation to determine that surfaces are free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
  - 2. Levelness: As required by manufacturer of finish flooring material to be installed. In absence of specific criteria from manufacturer, verify subfloor to be level within 3/16 inches in 10 feet.
    - a. Tolerances for Floors to Receive Ceramic or Stone Tile: Section 09 30 00.
  - 3. Surface Profile: Verify surface to be smooth troweled finish.
    - a. Fluid-Applied Flooring: Where roughened surface profile is required for bond of flooring system, create by mechanical means such as shot blasting or scarification under work of that flooring specification section.
- B. Patching: Thoroughly clean concrete floors before applying floor coverings. Remove rough spots and any foreign matter that might be evident through the floor covering. Patch minor rough areas, voids and defects with compatible leveling compound. .
- C. Leveling: Level major uneven concrete floor joints or other irregularities by bush hammering or grinding and filling with latex type underlayment. Leveled areas shall be sanded to provide a surface level plus-or-minus 3/16-inch in 10 feet unless flooring manufacturer stipulates stricter criterion. Leveled areas shall be inspected by the Architect before flooring work may proceed.

### 3.06 VAPOR EMISSION CONTROL TREATMENT

- A. General: Slab areas failing moisture testing shall receive specified vapor emission control treatment. Slab areas still failing test after treatment shall receive further treatment as recommended by vapor emission control treatment manufacturer until further testing demonstrates slab meets specified vapor emission limitation and slab surface is accepted for warrantable installation by finish flooring manufacturer(s).
- B. Protection: Mask and protect walls and equipment before beginning scarification and application.
- C. Surface Preparation: Shot blast concrete surface to expose uncontaminated, absorptive, and sound concrete. Do not acid etch concrete surface. Grind near wall base and clean all joints for treatment application. Broom-sweep and vacuum slab surfaces to remove dust and debris. Do not use clean sweeping agents.
  - 1. Fill all cracks, control joints, construction joints, and surface irregularities with resin and cementitious filling materials in accordance with system manufacturer's recommendations.
- D. Installation: Manufacturer's personnel or manufacturer-certified applicator shall treat slab surfaces in accordance with manufacturer's standard procedures for system and special instructions for specific test results and slab conditions encountered at this Project.
- E. Finishing: Apply primer and cementitious underlayment over treated slabs, using methods recommended by underlayment and treatment manufacturer.
- F. Vapor Emission Retesting: After application of vapor emission treatment, retest directly over treatment using calcium chloride method.

### 3.07 ALKALINITY NEUTRALIZATION TREATMENT

- A. General:
  - 1. Comply with finish flooring manufacturer's instructions. Treat slab surfaces with high measured pH using methods acceptable to finish flooring manufacturer only, and that will in no way void or compromise finish flooring warranty.
  - 2. Coordinate with MVER testing and relative humidity testing. If high pH is measured in concert with high MVER and/or relative humidity, follow procedures specified for slabs failing moisture testing, including, if required, vapor emission control treatment. Neutralization treatment procedures specified in this Article apply only to slabs with acceptable measured moisture vapor emission and relative humidity, but excessive pH at surface.
- B. Water Rinsing: Initial treatment shall consist of neutralizing the slab by rinsing with clean neutral water, using following procedure.
  - 1. Start with a clean, porous concrete.
  - 2. Spray a small area with clean neutral water, rinsing the slab. If in doubt about the water take a pH paper and test the water.
  - 3. Immediately after the application of the water, thoroughly wet vacuum the area rinsed to remove any excess water.
  - 4. Allow it to dry for 24 hours and retest to verify the slab is neutralized.
  - 5. Test pH of neutralized slab again after 7 days to verify pH has not returned to high levels before proceeding with finish flooring installation.
- C. Acid Washing: If water rinsing fails to neutralize slab surface to acceptable pH level, subject to acceptance of finish flooring manufacturer, neutralize slab surface by washing with mild carbonic acid, using following procedure.
  - 1. Spray club soda or similar mild carbonic acid onto the surface of the concrete.
  - 2. Wet vacuum the excess.
  - 3. Immediately rinse the acid with clean neutral water. Do not allow it to dry on the concrete.
  - 4. Wet vacuum the excess water and allow it to dry 24 hours.
  - 5. Test the surface to be verify the pH is neutralized.
  - 6. Test pH of neutralized slab again after 7 days to verify pH has not returned to high levels before proceeding with finish flooring installation.

### 3.08 CLEANING

- A. Before beginning installation of finish flooring materials and floor coatings, floor slabs shall be cleaned of dirt debris, contaminants and other deleterious materials on slab surfaces.
- B. Curing Compound Membranes and Other Coatings:
  - 1. Dissipating Curing Compounds, If Used: Verify complete dissipation of curing compound membrane.
  - 2. Remove residual curing compound membrane, paint, oils and similar contaminants using shotblasting or other acceptable mechanical cleaning method, or by specified chemical cleaner and stripper in accordance with manufacturer's instructions.
- C. Vacuum or broom-clean surfaces to be covered immediately before the application of flooring.

### 3.09 PROTECTION

- A. During and after flooring preparation, and until commencement of finish flooring installation, protect subfloor slab surfaces from staining, cracking, chipping, and other damage.

- B. Take precautions to protect slabs from exposure to significant excess moisture after end of curing period, during drying period, and until commencement of finish flooring installation.
  - 1. Do not wash construction tools or materials over floor slabs.
- C. Do not permit construction activities such as pipe cutting which could damage or stain floor slabs.
- D. Do not store materials on floor slabs that could expose concrete to oil contamination.

END OF SECTION



**SECTION 09 21 16  
GYPSUM BOARD ASSEMBLIES**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A Performance criteria for gypsum board assemblies.
- B Metal stud wall framing.
- C Metal channel ceiling framing.
- D Gypsum sheathing.
- E Gypsum wallboard.
- F Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A Section 05 40 00 - Cold-Formed Metal Framing: Structural steel stud framing.
- B Section 07 21 00 - Thermal Insulation: Acoustic insulation.
- C Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
- D Section 07 92 00-Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- E Section 09 22 16 - Non-Structural Metal Framing.

REFERENCE STANDARDS

- F Definitions: Meaning of the following terms as used in these Specifications.
  - 1. Gypsum Board Construction Terminology: Refer to ASTM C11 for definitions of terms for gypsum board construction not otherwise defined in this Section or in referenced standards.
  - 2. Drywall: Gypsum board.
- G Reference Standards: Comply with the following except as otherwise specified in this Project Manual:
- H ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017.
- I ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- J ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2018.
- K ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2019b.
- L ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base 2019.
- M ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel 2018.
- N ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- O ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2016.
- P ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- Q ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2019.
- R ASTM E413 - Classification for Rating Sound Insulation 2016.
- S GA-216 - Application and Finishing of Gypsum Panel Products 2016.

1.03 SUBMITTALS

- A See Section 01 25 00 - Substitution Procedures for submittal procedures.
- B Product Data: Provide data on metal framing, gypsum board, accessories and joint finishing system.
- C Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1. Include tables showing gage, depth and limiting unsupported heights for studs demonstrating that proposed stud systems and gages meet performance requirements specified for all conditions indicated on the Drawings. Highlight applicable lines in tables.

D Installer's Qualification Statement.

#### 1.04 QUALITY ASSURANCE

A Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

B Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

### PART 2 PRODUCTS

#### 2.01 GYPSUM BOARD ASSEMBLIES

A Provide completed assemblies complying with ASTM C840 and GA-216.

B Interior Partitions: Provide completed assemblies with the following characteristics:

1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
2. See Drawings for detailed assembly requirements.
  - a. Gypsum Board Panels: Unless indicated otherwise, provide panels 5/8 inch thick by 48 inch wide by vertical length to allow for vertical installation without cross joints.

#### 2.02 METAL FRAMING MATERIALS

A Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf ( L/120 at 240 Pa ).

1. Studs: "C" shaped with knurled or embossed faces.
2. Runners: U shaped, sized to match studs.
3. Ceiling Channels: C-shaped.

#### 2.03 BOARD MATERIALS

A Manufacturers - Gypsum-Based Board:

1. American Gypsum Company; American Gypsum Firebloc Type X: [www.americangypsum.com/#sle](http://www.americangypsum.com/#sle).
2. CertainTeed Corporation; CertainTeed Type X Gypsum Board: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
3. Georgia-Pacific Gypsum; ToughRock Fireguard X Gypsum Board: [www.gpgypsum.com/#sle](http://www.gpgypsum.com/#sle).
4. National Gypsum Company; Gold Bond Fire-Shield Gypsum Board: [www.nationalgypsum.com/#sle](http://www.nationalgypsum.com/#sle).
5. PABCO Gypsum; Pabco Flame Curb Type X Gypsum Board: [www.pabcogypsum.com/#sle](http://www.pabcogypsum.com/#sle).
6. USG Corporation; Sheetrock Brand Firecode X Gypsum Panels: [www.usg.com/#sle](http://www.usg.com/#sle).

B Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
3. Thickness:
  - a. Vertical Surfaces: 5/8 inch ( 16 mm ).
  - b. Ceilings: 5/8 inch ( 16 mm ).

C Backing Board For Wet Areas: One of the following products:

1. Application: Surfaces behind tile in wet areas including tub and shower surrounds, shower ceilings and [\_\_\_\_\_].

2. Application: Horizontal surfaces behind tile in wet areas including countertops and behind sinks.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
  - a. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch ( 16 mm ).
  - b. Products:
    - 1) CertainTeed Corporation; Diamondback 1/2" Tile Backer.
    - 2) CertainTeed Corporation; Diamondback 5/8" Type X Tile Backer.
    - 3) Georgia-Pacific Gypsum; DensShield Tile Backer.
    - 4) National Gypsum Company; Gold Bond eXP Tile Backer.

#### 2.04 GYPSUM WALLBOARD ACCESSORIES

- A Acoustic Insulation: As specified in Section 07 21 00.
- B Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
  1. Types: As detailed or required for finished appearance.
  2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
  3. Products:
    - a. Same manufacturer as framing materials.
    - b. Phillips Manufacturing Co: [www.phillipsmfg.com/#sle](http://www.phillipsmfg.com/#sle).
    - c. Trim-tex, Inc: [www.trim-tex.com/#sle](http://www.trim-tex.com/#sle).
    - d. Substitutions: See Section 01 60 00 - Product Requirements.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A Verify that project conditions are appropriate for work of this section to commence.

#### 3.02 FRAMING INSTALLATION

- A Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B Suspended Ceilings and Soffits: Space framing and furring members as indicated.
  1. Level ceiling system to a tolerance of 1/1200.
  2. Laterally brace entire suspension system.
  3. Install bracing as required at exterior locations to resist wind uplift.
- C Studs: Space studs at 16 inches on center ( at 406 mm on center ) unless otherwise indicated.
  1. Extend partition framing to structure where indicated and to ceiling in other locations.
  2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
  3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

#### 3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B Acoustic Sealant: Install in accordance with manufacturer's instructions.
  1. Place one bead continuously on substrate before installation of perimeter framing members.

#### 3.04 BOARD INSTALLATION

- A Comply with ASTM C840, GA-216 and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

- B Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

### 3.05 INSTALLATION OF TRIM AND ACCESSORIES

- A Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  1. Not more than 30 feet ( 10 meters ) apart on walls and ceilings over 50 feet ( 16 meters ) long.
- B Corner Beads: Install at external corners, using longest practical lengths.
- C Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

### 3.06 JOINT TREATMENT

- A Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- B Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
  2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  3. Level 3: Walls to receive textured wall finish.
  4. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
  5. Level 0: Temporary partitions.
- C Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  1. Feather coats of joint compound so that camber is maximum 1/32 inch ( 0.8 mm ).
  2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
- D Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

### 3.07 TOLERANCES

- A Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet ( 3 mm in 3 m ) in any direction.

**END OF SECTION**



**SECTION 09 22 26**  
**SUSPENSION SYSTEMS**

**PART 1 GENERAL**

1.01 SUMMARY

- A. Work Results:
  - 1. Metal suspension for gypsum board ceilings.
- B. Related Requirements:
  - 1. Cold-Formed Framing for Exterior Walls, Structural Metal Stud Framing and Cold-Formed Metal Joist Framing: Section 05 40 00 Cold-Formed Metal Framing.
  - 2. Ceiling and Soffit Joist Framing: Section 09 22 16 Non-Structural Metal Framing.
  - 3. Suspension Systems for Acoustical Panel Ceilings: Section 09 51 13 Acoustical Panel Ceilings.

1.02 REFERENCES

- A. Reference Standards: See Section 01 42 00. Comply with following:
  - 1. ASTM International Standards: [www.astm.org](http://www.astm.org).
    - a. ASTM C754-15 – Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
  - 2. Gypsum Association Standards: [www.gypsum.org](http://www.gypsum.org).
    - a. Fire Rated Construction: GA-600-2015 –Fire Resistance Design Manual.

1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Submit product data sheets for ceiling suspension system. Include all assembly components.

1.04 DELIVERY, STORAGE, AND HANDLING:

- A. General Requirements: Comply with Section 01 60 00.
- B. Storage and Handling Requirements:
  - 1. Store metals above ground on platforms, skids, or other supports. Protect metals from surface contamination and corrosion.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
  - 1. Armstrong; [www.armstrong.com](http://www.armstrong.com).
  - 2. Chicago Metallic; [www.chicagometallic.com](http://www.chicagometallic.com).
  - 3. United States Gypsum Company (USG); [www.usg.com](http://www.usg.com).

## 2.02 ASSEMBLIES

- A. Suspension Systems for Fire Rated Assemblies:
  - 1. Where UL design numbers are referenced on Drawings, assemblies shall comply with Underwriters Laboratories Inc. Fire Resistance Directory. See Sections 01 42 00 and 01 60 00.
  - 2. Where GA design numbers are referenced on Drawings, assemblies shall comply with GA-600.

## 2.03 DESIGN CRITERIA

- A. Seismic Suspension System Bracing: Ceiling suspension system and connections shall be designed and constructed as indicated on Drawings and in accordance with requirements of ICC Evaluation Service Report for ceiling suspension systems in Seismic Design Category adopted by local code.

## 2.04 COMPONENTS

- A. Hangers: Steel wire or rods, sizes to comply with requirements of ASTM C754 for ceiling or soffit area and loads to be supported.
  - 1. Wire: ASTM A641, minimum No. 9 gage, soft, Class 1 galvanized.
  - 2. Rods and Flats: Mild steel components.
- B. Suspended Framing System: Framing system for gypsum board panels consisting of cold-rolled steel members conforming to ASTM C635, including main tees, furring cross channels, furring cross tees, and cross tees.
  - 1. Main Runners: Cold rolled, "C" shaped steel channels, 16 gauge minimum.
    - a. Form to required radius at curved ceilings.
  - 2. Cross Furring: Hat shaped steel furring channels, ASTM C645, 7/8 inch high, 25 gauge, galvanized.
  - 3. Finish: Hot dipped galvanized finish, ASTM A653, Type G30 or better.
  - 4. Provide compression posts and other accessories as required to comply with seismic requirements.

## 2.05 ACCESSORIES

- A. Furring Anchorages: 16 gauge galvanized wire ties, manufacturer's standard wire type clips, bolts, nails or screws recommended by furring manufacturer and complying with ASTM C754.
- B. U-shaped channel molding.

## **PART 3 EXECUTION**

### 3.01 CEILING SUSPENSION INSTALLATION

- A. General: Install suspension system in accordance with ASTM C754 and manufacturer's instructions and as required to comply with seismic requirements..
- B. Hangers: Secure hangers to structural support by connecting directly to structure where possible, otherwise connect to cast in concrete inserts or other anchorage devices or fasteners as indicated. Install wire hangers spaced not over 48 inches on center in direction of 1-1/2-inch main runner channels and within 6 inches of ends of main runners or interruptions of ceiling

continuity. Hang from structure above. Install hangers 24 inches on center at gypsum drywall ceilings supporting wood or metal ceilings or other secondary ceiling systems.

1. Where spacing of structural members, or width of ducts or other equipment, prevents regular spacing of hangers, provide supplemental hangers and suspension members and reinforce nearest affected hangers to span extra distance.
  2. Attach directly to structural elements only. Do not connect or suspend steel framing from ducts, pipes or conduit. Loop hangers and wire tie directly or provide anchors or inserts.
  3. Keep hangers and braces 2 inches clear of ducts, pipes and conduits.
- C. At light troffers or other openings, reinforce framing with 3/4-inch cold rolled channels wired atop and parallel to main runner channels.
- D. Provide all necessary framing and suspension for offsets, verticals and decorative recesses, etc. Use drywall studs where indicated or required. See Section 09 22 16 for type.
- E. Install 1-1/2 inch main runner channels 24 inches on center. at ceilings supporting wood or metal ceilings or other secondary ceiling systems.
- F. Seismic Braced System:
1. Install compression posts, splay wires and other accessories as required to comply with seismic requirements.
  2. Extend runners to within 6 inches of walls.
  3. Wire tie or clip furring members to main runners and to other structural supports indicated. In fire resistance rated assemblies, wire tie furring members; do not clip.
  4. Do not permit furring or runners to contact masonry or concrete walls.
  5. Provide 1 inch clearance between furring or runners and abutting walls and partitions.
- G. Installation Tolerances:
1. Do not exceed 1/8 inch in 8' 0" variation from plumb or level in exposed lines of surface, except at joints between gypsum board units.
  2. Do not exceed 1/16 inch variation between planes of abutting edges or ends.
  3. Shim as required to comply with specified tolerances.

END OF SECTION



## SECTION 09 24 23

### CEMENT STUCCO

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section Includes:
  - 1. Metal lath.
  - 2. Portland cement stucco.
- B. Related Requirements:
  - 1. Paper-Based Water-Resistive Barriers: Section 09 25 11.

##### 1.02 REFERENCES

- A. General Requirements: Refer to Section 01 42 00.
- B. Reference Standards: Comply with following reference standards as applicable to the Work indicated.
  - 1. ASTM International Standard Specifications and Test Methods; [www.astm.org](http://www.astm.org):
    - a. ASTM C847-18 – Standard Specification for Metal Lath.
    - b. ASTM C926-20a - Standard Specification for Application of Portland Cement Based Plaster.
    - c. ASTM C1063-20 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
    - d. ASTM C1861-20 - Standard Specification for Lathing and Furring Accessories, and Fasteners, for Interior and Exterior Portland Cement-Based Plaster.

##### 1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Manufacturer's current product data sheets describing products to be supplied with all selected options clearly identified, basic uses, composition and materials, physical properties, precautions and limitations, applicable standards, approvals, and general installation procedures.
  - 1. Include each type of stucco material, finish material, metal lath, and lathing accessories to be installed.
- C. Samples: Submit two-foot by two-foot sample of color and texture of Portland cement stucco formulated to match existing stucco.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. General Requirements: Comply with Section 01 60 00 and with Manufacturer's recommendations.
- B. Delivery and Acceptance Requirements:
  - 1. Deliver all materials in their original sealed containers bearing manufacturer's name and identification of product.

- C. Storage and Handling Requirements:
  - 1. Store materials off ground and under cover in dry area.
  - 2. Store stucco materials at temperatures not less than 40 degrees F and not in excess of 90 degrees F (32 degrees C). Store away from direct sunlight.
  - 3. Protect Portland cement based materials (bag products) from moisture and humidity. Store under cover off the ground in a dry location.
  - 4. Protect metal accessories from rusting during storage.
  - 5. Rusted and water damaged materials will be subject to rejection.

## 1.05 AMBIENT CONDITIONS

- A. Hot Weather Protection:
  - 1. Apply cement stucco when ambient and surface temperatures are below 100 degrees F.
  - 2. Hot Weather Protection: Protect stucco against uneven or excessive evaporation during dry, hot weather and from strong blasts of dry air, either natural or artificial.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable Stucco Manufacturers: Provide stucco base coats, primer and finish coat from single source manufacturer.
  - 1. Omega Products International, Inc.; [www.omega-products.com](http://www.omega-products.com).
  - 2. Parex USA, Inc.; [www.parex.com](http://www.parex.com), including the following brands:
    - a. El Rey Stucco; [www.elrey.com](http://www.elrey.com).
    - b. LaHabra Stucco; [www.lahabrastucco.com](http://www.lahabrastucco.com).
  - 3. QUIKRETE; [www.quikrete.com](http://www.quikrete.com).
  - 4. Western Blended Products; [www.westernblended.com](http://www.westernblended.com).
- B. Acceptable Manufacturers – Metal Lath and Stucco Accessories:
  - 1. Alabama Metal Industries Corporation (AMICO).
  - 2. California Expanded Metal Products Company (CEMCO); [www.cemcosteel.com](http://www.cemcosteel.com).
  - 3. ClarkDietrich Building Systems LLC, [www.clarkdietrich.com](http://www.clarkdietrich.com).
  - 4. Phillips Manufacturing Company; [www.phillipsmfg.com](http://www.phillipsmfg.com).
  - 5. WARE Industries, Inc. dba MarinoWARE; [www.marinoware.com](http://www.marinoware.com).

### 2.02 PORTLAND CEMENT STUCCO MATERIALS

- A. Portland Cement: ASTM C150, Type I.
- B. Hydrated Lime: ASTM C206.
- C. Aggregate: ASTM C897. Clean natural or manufactured sand, free from deleterious amounts of loam, clay, salt, soluble salts and organic matter.
  - 1. Finish Coat Aggregate: Fine silica sand complying with requirements listed above.
- D. Water: Clean, potable and free from injurious amounts of oils, acids, alkalis, salts, organic materials or substances that may be deleterious to stucco or metals in contact with stucco.

### 2.03 PORTLAND CEMENT STUCCO MIXES

- A. Each Coat of Job-Site-Mixed Portland Cement Stucco: One part Portland cement to three to five parts of sand. Hydrated lime may be added for plasticity in amount of 10 percent by weight or 25

percent volume. Should anti-hydro be used in place of lime, use one quart per sack of Portland cement with no additional additive.

- B. Finish Coat: Match existing. Integrally colored cementitious stucco finish coat if applicable.

#### 2.04 ELASTOMERIC FINISH

- A. Finish Coat: Acrylic polymer-based, elastomeric, exterior wall system finish to match existing, if applicable.
  - 1. Texture to match existing adjacent stucco.
  - 2. Vapor permeable.
  - 3. Stain resistant.
  - 4. Water-repellent.
  - 5. UV resistant.
  - 6. Mold resistant.
  - 7. Bridges cracks up to 1/32-inch in width.
- B. Color: Match existing.

#### 2.05 LATHING MATERIALS

- A. Expanded-Metal Lath: ASTM C847.
  - 1. Weight:
    - a. At Soffits and Overhangs: 3.4 lb./sq. yd.
    - b. Other Locations: 2.5 lb./sq. yd. Contractor's option as alternative to stucco netting.
  - 2. Galvanized Coating: ASTM A653, G40 minimum.
  - 3. Type: Self-furring, with dimples to hold the metal lath 1/4 inch away from the surface to be plastered.
  - 4. Strip Lath: Provide diamond lath in 4-inch and 6-inch wide striplath with smooth edges at all soffits, overhangs, windows, doorways and openings, as shown on Drawings.
  - 5. At Corners: Provide diamond lath formed to an angle with smooth edges.
- B. Cross Wire: No. 9 gage galvanized wire.
- C. Tie Wire: No. 16 or No. 18 gage galvanized wire.

#### 2.06 STUCCO EDGE, CORNER, AND JOINT REINFORCEMENT ACCESSORIES AND SCREEDS

- A. General: Weep screed, casing bead, corner bead, corner lath, expansion and control joint accessories shall meet the requirements of ASTM C1063 and its referenced documents:
  - 1. Acceptable Materials:
    - a. Galvanized Steel: ASTM A653 with G60 coating.
    - b. Zinc Alloy: ASTM B69.
  - 2. All accessories shall have perforated or expanded flanges and shall be designed with grounds for the specified thickness of stucco.
- B. Casing Beads: J-metal or plaster stop, general-purpose type with expanded or perforated flanges.
- C. Weep Screed: Galvanized sill screed with holes for drainage.

## 2.07 WEATHER RESISTANT BARRIERS

- A. Building Paper: Comply with Section 07 25 11. Asphalt impregnated, water resistant building paper, Type D. Minimum 1 layer of grade-D 15 pound building paper, 2 layers over all wood based substrates.

## 2.08 MECHANICAL FASTENERS

- A. General: Provide appropriate non-corroding fasteners, depending on the type framing or substrate:
- B. Fasteners Into Wood Framing: Minimum 11 gauge, 7/16 inch (11 mm) diameter head galvanized roofing nails with minimum  $\frac{3}{4}$  inch (19mm) penetration into studs or minimum No.8 Type S wafer head fully threaded corrosion resistant screws with minimum  $\frac{3}{4}$  inch (19 mm) penetration into studs.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verification of Conditions: Comply with Section 01 71 16.
  - 1. Layout: Verify layout of work before beginning installation.
  - 2. Substrate: Examine substrate before beginning installation.
    - a. Verify substrates are free of dust, loose particles, frost, oil, form release agents or any foreign matter that could affect bond or proper hydration of cement stucco.
    - b. Verify substrate surface will allow finished stucco surfaces to be true to line, level and plumb.
- B. Notification: Notify General Contractor of unsatisfactory conditions in writing with copy to Architect.
- C. Acceptance: Beginning of work means acceptance of existing conditions by installer.

### 3.02 PREPARATION

- A. Protection:
  - 1. Protect finished surfaces installed prior to plastering. Provide drapes and drop cloths necessary to protect walls, floors, ductwork and piping, electrical work, etc. during plastering operations.
  - 2. Maintain protection in place until completion of work.
- B. Building Paper: Section 07 25 11. Cover entire surface to receive lath; lap all joints and secure to wood studs.
- C. Mixing: Mix in accordance with manufacturer's written instructions to achieve indicated and specified results..

### 3.03 INSTALLATION, GENERAL

- A. General: Install stucco to comply with all applicable codes and standards and with requirements of local agencies having jurisdiction.
  - 1. Apply with sufficient force to develop full adhesion between stucco and substrate.
  - 2. Workmanship: Perform work true to line, straight and plumb.
    - a. Finished Surfaces: Free from waves, dents, and other imperfections.



- b. Execute work to avoid any irregularity occurring at point or place where one section is joined to another.
  - c. Arises and Angles: True and sharp.
- B. Number of Coats and Nominal Thickness: Apply in three coats, consisting of nominal 3/8-inch thick scratch coat, nominal 3/8-inch thick brown coat, and finish coat, for a total nominal thickness of 7/8-inch.
- C. Casing Beads: Install where stucco surfaces finish against concrete, masonry or other exposed surfaces and elsewhere as indicated on Drawings.
- D. Drip Screeds: Install at intersections of vertical and horizontal surfaces.

### 3.04 APPLICATION OF CEMENTITIOUS STUCCO

- A. Apply cementitious stucco in accordance with ASTM C926.
- B. Weep Screed Installation: Install foundation weep screed at the base of the wall securely to framing with the appropriate fastener.
1. Locate foundation weep screed so that it overlaps the joint between the foundation and framing by a minimum of 1-inch.
- C. Casing Bead and Joint Installation:
1. Install casing beads at stucco terminations, doors, windows and other through-wall penetrations.
  2. Install full accessory pieces where possible and avoid small pieces.
  3. Seal adjoining pieces by embedding ends in sealant.
  4. Abut horizontal into vertical joint accessories.
  5. Attach at no more than 7 inches on center into framing with appropriate fasteners.
  6. Moisture protection shall be continuous behind joints and accessories.
- D. Lathing:
1. Diamond Mesh Metal Lath Over WRB, Sheathing, and Framed Walls:
    - a. General: Install metal lath with the long dimension at right angles to structural framing. Terminate lath at expansion joints. Do not install continuously beneath joints.
    - b. Seams/Overlaps: Overlap side seams minimum 1/2 inch and end seams minimum 1 inch. Stagger end seams. Overlap casing beads and expansion joints minimum 1 inch over narrow wing accessories, minimum 2 inches over expanded flange accessories. Do not install lath continuously beneath expansion joints.
    - c. Penetrations: Apply strip lath (butterflies) at all corners of penetrations.
    - d. Attachment: Fasten securely through sheathing into structural framing at 7 inches on center maximum vertically and 16 inches on center horizontally. Wire tie at no more than 9 inches on center at: side laps, accessory overlaps, and where end laps occur between supports.
- E. Scratch Coat:
1. Apply first coat to minimum uniform 3/8-inch thickness using sufficient trowel pressure to key stucco into lath and to completely embed lath.
  2. Prior to initial set, scratch horizontally to provide key for bond of brown coat.
  3. Brown coat may be applied as soon as the scratch coat has achieved sufficient rigidity to support the brown coat. If brown coat application does not follow immediately upon scratch coat setting, moist cure scratch coat with clean potable water for at least 48 hours in accordance with ASTM C926.

- F. Brown Coat: Apply uniformly to provide a minimum uniform 3/8-inch thickness using sufficient trowel pressure to key stucco into scratch coat.
  - 1. Rod off to desired thickness, leveled to screeds, to provide a true, flat plane.
  - 2. After the stucco has become slightly firm float the surface lightly with a darby or wood float to densify the surface and to provide a smooth, even surface.
  - 3. Fill all voids and dress surface for finish coat.
  - 4. Trowel to smooth and uniform surface to receive acrylic polymer elastomeric finish coat.
  - 5. Tool brown coat to provide V-joint at intersection of stucco and materials which act as plaster grounds.
  - 6. Interrupt or delay stucco application only at junctions of stucco planes, openings, or expansion or control joints.
  - 7. Moist cure brown coat with clean potable water for at least 48 hours, in accordance with ASTM C926 and the building code.
    - a. Moist cure after the stucco has set by lightly fogging for at least 48 hours. Fog as frequently as required during the 48 hour period to prevent loss of moisture from the stucco.
    - b. Avoid eroding the stucco surface with excess moisture. If relative humidity exceeds 75 percent the frequency of moist curing may be diminished.
- H. Cement Based Stucco Finish Coat, if Applicable: Apply to match existing adjacent stucco.
  - 1. Apply finish coat using sufficient trowel pressure or spray velocity to bond finish coat to basecoat.
- I. Allowable Tolerances: Maximum deviation from true plane of 1/8-inch in 5 feet as measured by straight edge placed at any location on surface.
- J. Protect installed cementitious stucco from dust, dirt, rain, snow, and frost for 72 hours following application.
- K. Protect finished work when stopping for the day or when completing an area.

### 3.05 CURING

- A. Moist cure cement based basecoats with light spray of clear water with sufficient frequency to maintain uniformly moist condition for minimum of 48 hours following application.
- B. Moist cure cement based finish coats with light spray of clear water with sufficient frequency to maintain uniformly moist condition for minimum of 48 hours following application.

### 3.06 ELASTOMERIC FINISH APPLICATION, IF APPLICABLE TO MATCH EXISTING

- A. After moist curing, allow the stucco base to air dry.
- B. Primer Installation: Apply primer evenly with brush, roller or proper spray equipment over the clean, dry stucco and foam build-outs, and allow to dry thoroughly before applying finish.
- C. Apply fiberglass reinforcing mesh over polystyrene shapes and build-outs where indicated.
- D. Finish Coat Application: Comply with manufacturer's instructions.
  - 1. Apply finish coat to thickness recommended by manufacturer and in number of coats and consistency necessary to achieve texture to match approved sample area, using sufficient trowel pressure or spray velocity to bond finish to base coat.
  - 2. Apply finish directly over the stucco base and foam build-outs.
  - 3. Avoid application in direct sunlight.

4. Apply finish in a continuous application, and work a wet edge towards the unfinished wall area. Work to an architectural break in the wall before stopping to avoid cold joints, and so that completed finish is free of scaffold lines and other imperfections..
  5. Do not install separate batches of finish side-by-side.
  6. Do not apply finish into or over joints or accessories. Apply finish to outside face of wall only.
- E. Finished Surface: Finish coat in which fine cracks, pits, checks, waves, streaks, catfaces, blisters or other defects may develop, will not be accepted. Cut out and properly replace such areas.
- F. Provide protection of installed finish from inclement weather, dust, dirt, precipitation, freezing and continuous high humidity until fully dry.
- G. Air dry acrylic based and elastomeric finish coats only; do not wet cure.

### 3.07 PATCHING

- A. Upon completion of stucco work, point up finish coat around trim and any location where finish coat terminates or meets dissimilar materials.
1. Cut out and replace defective or damaged finish coat.
  2. Match pointing and patches to surrounding finish coat in form and texture.

### 3.08 CLEANING

- A. Clean surfaces splattered with plaster as recommended by manufacturer.
1. Remove finish and protective materials from perimeter trim and adjacent surfaces.
- B. Remove all excess materials from Project site.

### 3.09 PROTECTION

- A. Provide protection of installed materials from water infiltration into or behind them.

END OF SECTION



**SECTION 09 51 13**  
**ACOUSTICAL PANEL CEILINGS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A Work Results:
  - 1. Acoustical grid and suspension system for CBC seismic Category F.
  - 2. Lay-in panels.
- B Related Requirements:
  - 1. Gypsum Board Ceilings: Section 09 21 16 Gypsum Board Assemblies.
  - 2. Interior Painting: Section 09 91 23.

**1.02 REFERENCES**

- A Reference Standards: See Section 01 42 00. Comply with the following.
  - 1.
  - 2. ASTM International References:
    - a. ASTM C635/C635M-13a - Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
    - b. ASTM C636/C636M-13 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
    - c. ASTM E580/E580M-14 – Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
    - d. ASTM E1264-14 - Standard Classification for Acoustical Ceiling Products.

**1.03 SEQUENCING**

- A Do not install acoustical ceilings until dust-generating activities are completed, wet work has dried and overhead mechanical work is completed.

**1.04 ACTION SUBMITTALS**

- A Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B Product Data: Submit manufacturer's catalog data indicating all systems proposed for installation. Include details of light fixture protection (if any) required to comply with Article "Performance." If Fixture protection is not required, submit manufacturer's written data so indicating. Also submit specific requirements for holddown clips (if any).
- C Samples: Submit samples of each type of lay-in panel meeting the requirements of this specification to the Architect.

**1.05 INFORMATIONAL SUBMITTALS**

- A Procedures: Submit for information and verification in accordance with Section 01 33 00.
- B Test and Evaluation Reports:
  - 1. Submit current ICC-ES Evaluation Report (ESR) showing compliance with ICC-acceptance criteria.
- C Manufacturer's Instructions:
  - 1. Submit Manufacturer's installation instructions.
    - a. Maintain one additional copy on site until completion of installation.

**1.06 MAINTENANCE MATERIALS SUBMITTALS**

- A Extra Materials: Provide Owner with 1 percent of gross area installed, maximum of two cases, of each type of ceiling panel used.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A General Requirements: Comply with Section 01 60 00.
- B Deliver in manufacturer's original unopened containers and store in a clean, dry area until ready for use.

**1.08 AMBIENT CONDITIONS**

- A Maintain minimum of 60 degrees F during and after installation of acoustical ceilings.

## **PART 2 PRODUCTS**

### **2.01 PRODUCT OPTIONS**

A Substitution Requests: Required for all manufacturers and products not named as Basis of Design or as Acceptable Manufacturer and Product.

1. Submit in accordance with Section 01 25 00.

### **2.02 REGULATORY REQUIREMENTS**

A Seismic Design Compliance: Metal suspension systems and lay-in panel ceilings provided under this Section shall meet the requirements of the CBC for Seismic Design Category F. Systems shall be designed and installed in accordance with ASTM C635, ASTM C636, and ASTM E580, Section 4 – Seismic Design Category F.

1. Systems with a current ICC-ES report recognizing the system as a code-compliant alternative method for installation in Seismic Design Category F construction will be deemed to meet this requirement. Comply with all stipulations and conditions of use stated in the ICC-ESR.

### **2.03 PERFORMANCE**

A Acoustical Performance:

1. Lay-in panels shall have a minimum noise reduction coefficient (NRC) as of .55 in accordance with ASTM C423 and a CAC rating of the ceiling assembly of 35 in accordance with ASTM E1414.

B Fire Resistance:

1. Flame Spread: Do not exceed flame spread classifications in CBC Table 803.11.
2. System fire rating not required.

### **2.04 ACOUSTICAL LAY-IN CEILING PANELS**

A Acoustical Lay-In Panels: Match existing.

### **2.05 SUSPENSION SYSTEMS**

A Ceiling Suspension System: Match existing.

B Edge Molding: Standard angle molding for seismic suspension system, color to match grid.

1. Minimum Horizontal Flange Dimension: 7/8-inch.
2. Minimum Vertical Flange Dimension: 7/8-inch.

C Spacer Bars: Provide system as required to prevent perimeter components from spreading apart.

D Suspension Wire: Minimum No. 12 gauge galvanized, soft-annealed, mild steel wire.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF SUSPENSION SYSTEMS**

A General: Install suspension systems in accordance with Drawings, ASTM C636, ASTM E580, and manufacturer's instructions.

1. Reflected Ceiling Plan: Follow reflected ceiling plan on Drawings in layout of grid. Deviations must receive prior acceptance by Architect.
2. Install metal edge molding wherever the suspended grid abuts walls, columns and other vertical surfaces.
3. Frame around openings as required.
4. Suspension wires shall not hang more than one in six out of plumb unless countersloping wires are provided.
5. Provide a minimum 3/8-inch clearance from the wall on all sides at terminal ends of suspension members. Overlap metal edge molding angles a minimum of 3/8-inch. Do not fasten terminal ends to wall or to metal edge molding angle. Fasten to prevent terminal ends of main runners and cross runners from spreading.

B Exposed Grid Suspension System:

1. Install main T-runner on 48-inch centers.

2. To complete a 24-inch by 48-inch grid, install 48-inch cross T-splines 24 inches on center at right angles to main T-runners.
  - a. Install additional cross T-splines to form 24-inch grid.
3. Lock T-spline intersecting moldings in place. All main T-runners and cross T-splines shall be straight in alignment and flush at intersections.
4. Avoid use of less than half width units at borders.
5. Install edge molding at all intersections with dissimilar vertical surfaces. End joints for edge moldings shall occur only at T-Runners or Cross T-splines and shall have riveted connections.

### 3.02 INSTALLATION OF LAY-IN PANELS

- A Panels: Install panels in accordance with manufacturer's instructions and recommendations. Where required, cut units to fit.
  1. Install square edge panels flush in grid and beveled and tegular edge panels so that grid is recessed behind face of panels. Ensure each panel to be well supported on all four edges.
  2. Where panels run continuous over tops of partitions or where required for specified fire rating, provide holddown clips so panels fit tight to tops of partitions.
- B Hurricane Clips: Install at all open areas and within 20 feet of entrances.

### 3.03 LIGHTING FIXTURE INSTALLATION AND PROTECTION

- A Mechanically attach all lighting fixtures to ceiling suspension system in accordance with the NEC and ASTM E580 unless fixtures are independently supported.
- B If required for fire resistance assembly specified and by manufacturer's design number install box, tent or flat cover fixture protection as applicable to the assembly being installed.

### 3.04 SITE QUALITY CONTROL

- A Special Inspection: Special inspection is required for the suspension system, anchoring and bracing of the system. See Section 01 45 20.

### 3.05 FINAL APPEARANCE

- A On completion, acoustical panels shall be free from defects, clean and lying flat in metal grid.
- B Remove and replace dirty, defaced, scarred or otherwise defective panels. Touch up of scarred panels not acceptable.

**END OF SECTION**

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**SECTION 09 65 13  
RESILIENT BASE AND ACCESSORIES**

**PART 1 GENERAL**

1.01 SUMMARY

- A Section Includes:
  - 1. Rubber base.

1.02 REFERENCES

- A Reference Standards: See Section 01 42 00.
  - 1. ASTM D256 - 10 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics;2010 (Reapproved 2018)
  - 2. ASTM F1861-08 - Standard Specification for Resilient Wall Base.

1.03 ACTION SUBMITTALS

- A Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B Product Data: Submit manufacturer's catalog data for all products proposed for installation.
- C Samples: Submit samples for verification of each brand of base specified.

1.04 MAINTENANCE MATERIALS SUBMITTALS

- A Provide the Owner at the completion of the Project the following items:
  - 1. One gallon of each type of adhesive used.

1.05 DELIVERY, STORAGE, AND HANDLING

- A General Requirements: Comply with Section 01 60 00.
- B Temperature: Store materials in original containers at not less than 70 deg F for not less than 24 hours immediately before installation.

1.06 AMBIENT CONDITIONS

- A Maintain temperature in space to receive base between 70 degrees F and 90 degrees F for not less than 24 hours before and 48 hours after installation.

**PART 2 PRODUCTS**

2.01 RESILIENT BASE

- A Rubber Cove Base: ASTM F1861, Group 1. Type TS, thermoset vulcanized extruded rubber cove.
  - 1. Height:
    - a. 6 inches at Soiled Utility Room.
- B Provide pre-formed external corners. Job-formed internal corners may be used at Contractor's option.
- C Colors: Match existing..
- D Fire Resistance:
  - 1. Flame Spread: Do not exceed flame spread classifications in CBC Table 803.11.

2.02 ADHESIVE

- A Adhesive: As recommended by the manufacturer of the material being installed. Adhesive shall be a type not affected by heat.
  - 1. Low-Emitting Material Requirements: Use adhesives that comply with the limits for VOC content of SCAQMD Rule #1168:

**PART 3 EXECUTION**

3.01 EXAMINATION

- A Verification of Conditions: Examine substrate for unevenness that would prevent execution and quality of resilient base as specified. Report unsatisfactory conditions to the General Contractor.
- B Acceptance: Do not proceed with installation of resilient base until defects have been corrected. Beginning of installation means acceptance of existing substrate.

### 3.02 APPLICATION OF ADHESIVES

- A General: Mix and apply adhesives in accordance with manufacturer's instruction. Provide safety precautions during mixing and applications as recommended by adhesive manufacturer. Cover only that amount of area that can be covered by base within the recommended working time of the adhesive.
- B Application: Apply adhesive uniformly over surfaces with notched trowel or other suitable tool. Clean trowel and rework notches as necessary to insure proper application of adhesive.
- C Cleaning: Remove any adhesive that dries or films over. Do not soil walls or adjacent areas with adhesives. Promptly remove spillage.

### 3.03 INSTALLATION

- A Base: Tightly cement base to wall with butt joints 1/16-inch or less in width.

### 3.04 CLEANING

- A Upon completion, remove loose, cracked, chipped, stained or otherwise defective base and replace in a satisfactory manner. Clean surfaces using only cleaners approved by the manufacturer. Remove mastic cement from adjoining work with particular care to not damage such work.

**END OF SECTION**

**SECTION 09 65 16  
RESILIENT SHEET FLOORING**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A Section Includes:
  - 1. Sheet vinyl flooring with integral cove base.
- B Related Requirements:
  - 1. Finish Legend on Drawings.
  - 2. Concrete Floor Slab Moisture Testing: Section 09 05 61 Common Work Results for Flooring Preparation.

**1.02 REFERENCES**

- A Reference Standards: See Section 01 42 00. Comply with the following.
  - 1. ASTM International (ASTM):
    - a. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing 2004 (Reapproved 2014).
    - b. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2016a.
    - c. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.
  - 2. Resilient Floor Covering Institute (RFCI):
    - a. RFCI Standard Slab Moisture Test Method (Calcium Chloride Method).
- B Guide References and Standard Practices: Comply with recommendations of the following except as otherwise specified in this Project Manual.
  - 1. ASTM International Standard Practices:
    - a. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2019, with Editorial Revision (2020).

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A Coordination:
  - 1. Concrete Subfloor Vapor Emission, Alkalinity and Bond Testing and Acceptance: Coordinate with Section 09 05 61.
    - a. Notwithstanding testing by others, it is the responsibility of the flooring installer to determine whether the subfloor is sufficiently dry for covering.
- B Sequencing:
  - 1. Finishing Operations: Install flooring after finishing operations, including painting and ceiling operations, have been completed.
- C Scheduling:
  - 1. Material shall not be delivered or installed until all concrete, masonry and painting work are completed and all mechanical work, lighting and other overhead equipment are installed.

**1.04 ACTION SUBMITTALS**

- A Submittals for Review: Submit the following in accordance with Section 01 33 00:
- B Product Data: Submit manufacturer's current printed product literature and specifications for all products proposed for installation.
- C Shop Drawings: Submit shop drawings to indicate materials, details, and accessories including but not limited to the following:
  - 1. Submit a cut diagram indicating seam locations and roll direction. Use mitered seam layouts for corners when changing directions 180 degrees (e.g. when running material down corridors which bisect at a right angle), unless approved otherwise.
- D Samples: Submit for verification the brand and color of sheet vinyl to be used.
  - 1. Samples shall be complete and up to date.

2. Submit duplicate 12 inch by 12 inch sample pieces of sheet material, 12 inch long gully edge, cap strip, joint cover strip, or cove former as applicable.

#### 1.05 INFORMATIONAL SUBMITTALS

- A Procedures: Submit for information and verification in accordance with Section 01 33 00.
- B Manufacturer's Instructions:
  1. Manufacturer's Installation Instructions:
    - a. Maintain one copy on site until completion of installation.

#### 1.06 CLOSEOUT SUBMITTALS

- A Submittals for Project Record: Submit the following in accordance with Section 01 78 00.
- B Operation and Maintenance Data: Submit manufacturer's maintenance instructions.
  1. Include recommended cleaning and maintenance methods and materials and frequency of cleaning.
  2. Include precautions against cleaning materials and methods detrimental to finishes and performance.

#### 1.07 MAINTENANCE MATERIALS SUBMITTALS

- A Extra Materials: Upon completion of the Project, deliver the following materials to the Owner for future maintenance and repair:
  1. Sheet flooring pieces over 4 sq. ft.
  2. One gallon of each type of adhesive used.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A General Requirements: Comply with Section 01 60 00.
- B Delivery and Acceptance Requirements: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C Storage and Handling Requirements: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
  1. Maintain area where materials are to be stored at 55 degrees F and less than 50 percent relative humidity.
  2. Store rolls in dry locations. Stand rolls on end. Protect and secure rolls from falling.

#### 1.09 AMBIENT CONDITIONS

- A General: Comply with manufacturer's recommendations.
- B Before beginning work, building shall be warm, dry and well ventilated.
- C Temperature Requirements: Maintain temperature in space to receive base between 70 degrees F and 90 degrees F for not less than 24 hours before and 48 hours after installation. Following 48 hour period maintain minimum temperature of 55 deg F until completion of Work.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS AND PRODUCTS

- A Basis of Design Manufacturer and Products: See Finish Legend on Drawings.
  1. Manufacturer: Mannington Resilient Floors; [www.mannington.com](http://www.mannington.com).
- B Substitution Requests: In accordance with Section 01 25 00.

#### 2.02 PERFORMANCE

- A HUD/FHA Requirements: Exceed.
- B Flooring Radiant Panel Test (ASTM-E648): 0.45 watts/ cm<sup>2</sup>, Pass - Class 1.
- C N.B.S. Smoke Chamber Test (ASTM-E662): Less than 450 – Pass.
- D Fire Resistance:
  1. Flame Spread: Do not exceed flame spread classifications in CBC Table 803.11.

#### 2.03 SHEET VINYL FLOORING (SV) MATERIALS

- A Heterogeneous Sheet Vinyl Flooring With Backing: ASTM F1303, Type 2, Grade 1, Class A.
  1. Gauge:
    - a. Overall Nominal Thickness: 0.080 inch
    - b. Wearlayer Thickness: 0.080 inch.

2. Height: As indicated on drawings.

#### 2.04 ACCESSORIES

- A Adhesives: As recommended by the flooring manufacturer of the material being installed. Adhesive for vinyl edging and base shall be a type not affected by heat.
  1. Low-Emitting Material Requirements: Use adhesives that comply with the limits for VOC content of SCAQMD Rule #1168:
- B Heat Welding Rod: Color matched or multi-color welding rod as supplied by the flooring manufacturer.
- C Leveling Compound: Ardex Feather Finish or accepted substitute.
- D Edge Strips: Metal type.
- E Sealer and Wax: Type recommended by flooring manufacturer.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A Verification of Conditions: Examine substrate for excessive moisture content and unevenness which would prevent execution and quality of resilient flooring as specified. Report unsatisfactory conditions to the General Contractor with copy to Architect.
  1. Test moisture content of concrete before installation. Coordinate with vapor emission testing requirements of Section 09 05 61. If moisture is above level acceptable to flooring or adhesive manufacturer, seal concrete surface as recommended by flooring manufacturer.
  2. Verify concrete subfloor to be clean, level, sound and fully cured.
- B Acceptance: Do not proceed with installation of resilient flooring until defects have been corrected except where correction is indicated under Preparation. Beginning of installation means acceptance of existing substrate.

#### 3.02 PREPARATION

- A Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.
- B Subfloor Preparation:
  1. General: Prepare floor substrate in accordance with manufacturer's instructions.
  2. Concrete Subfloor:
    - a. Reference Standard: Comply with ASTM F710.
    - b. Cleaning, Patching and Priming: Thoroughly clean concrete floors before applying floor coverings. Remove rough spots and any foreign matter that might be evident through the floor covering. Patch minor rough areas, voids and defects with compatible leveling compound. Prime concrete floors as recommended by the manufacturer of the flooring.
    - c. Leveling: Level major uneven concrete floor joints or other irregularities by bush hammering or grinding and filling with latex type underlayment. Leveled areas shall be sanded to provide a surface level within 1/4-inch in 10 feet. Leveled areas shall be inspected by the Architect before flooring work may proceed.
- C Subfloor Testing:
  1. Concrete Moisture Test: Coordinate with Section 09 05 61. Perform moisture tests on concrete floors regardless of the age or grade level. Verify concrete substrate is dry in accordance with the RFCI Industry Standards Slab Moisture Test Method (Calcium Chloride Method), in strict accordance with instructions.
    - a. Perform moisture condition test in each major area. A minimum of 1 test per 93 m2 (1000 sq.ft), prior to installation. Moisture emissions from concrete subfloors must not exceed 3 lbs per 1000sf per 24 hours (1.4 kg H2O/24 hr/93 m2) for acrylic adhesive and 5lbs for polyurethane adhesive via the Calcium Chloride Test Method (ASTM F1869).

- b. Conduct moisture tests around room perimeter, at columns and where moisture may be evident.
2. Concrete pH Test: Perform alkali tests to ensure pH levels of concrete subfloor surface do not exceed pH 9.9. Concrete must be neutralized if above pH 9.9.
3. Do not proceed with work until results of moisture condition and/or pH tests are acceptable.

### 3.03 APPLICATION OF ADHESIVES

- A General: Mix and apply adhesives in accordance with manufacturer's instruction. Provide safety precautions during mixing and applications as recommended by adhesive manufacturer. Cover only that amount of area which can be covered by flooring material within the recommended working time of the adhesive.
- B Application: Apply adhesive uniformly over surfaces with notched trowel or other suitable tool. Clean trowel and rework notches as necessary to insure proper application of adhesive.
- C Cleaning: Remove any adhesive which dries or films over. Do not soil walls, bases, or adjacent areas with adhesives. Promptly remove spillage.

### 3.04 INSTALLATION

- A General: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- B Sheet Vinyl Flooring: Install according to manufacturer's recommendations. Rout seams with a hand router or electric router and heat weld seams using matching vinyl welding thread. Install fillet cove filler at all walls. Turn sheet flooring up wall to form integral cove base and install aluminum trim at exposed top edge.

### 3.05 CLEANING

- A General:
  1. Remove temporary coverings and protection of adjacent work areas.
  2. Repair or replace damaged installed products.
  3. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
  4. Remove construction debris from Project site and legally dispose of debris.
- B Remove visible adhesive and other surface blemishes using cleaning methods recommended by floor manufacturer. Remove mastic cement from adjoining work with particular care to not damage such work.
- C Sweep and vacuum floor after installation.
- D Clean surfaces using only cleaners approved by the manufacturer.
- E Buffing: Dry mop and buff flooring.
- F Final Cleaning: Mop with warm water and mild detergent as recommended by manufacturer of flooring, then thoroughly machine buff.

### 3.06 PROTECTION

- A Protect finished work from damage by subsequent construction operations.
- B After flooring is installed, the room shall be kept locked to allow curing time for adhesive. No other trades shall be allowed on the floor until it is accepted by the Architect.
- C Protect the newly installed flooring from foot traffic for 24 hours and heavy rolling traffic for 72 hours.

**END OF SECTION**

**SECTION 09 81 16**  
**ACOUSTIC BLANKET INSULATION**

**PART 1 GENERAL**

1.01 SUMMARY

- A Section Includes:
  - 1. Acoustical insulation in partitions as indicated.
  - 2. Acoustical insulation over ceilings as indicated.
- B Related Requirements:
  - 1. Acoustical Joint Sealants: Section 07 92 00 Joint Sealants.

1.02 ACTION SUBMITTALS

- A Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B Product Data: Submit manufacturer's current product literature.
- C Samples: Submit manufacturer's sample, minimum 6 inches square.

1.03 DELIVERY, STORAGE, AND HANDLING

- A General Requirements: Comply with Section 01 60 00.
  - 1. Protect acoustical materials from excessive moisture in shipment, storage, and handling.
- B Delivery and Acceptance Requirements:
  - 1. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying material name and manufacturer, production date and/or product code.
- C Storage and Handling Requirements:
  - 1. Storage: Store materials in a clean, dry area in accordance with manufacturer's instructions.
  - 2. Handling: Protect materials during handling and installation to prevent damage.

**PART 2 PRODUCTS**

2.01 FIBER GLASS ACOUSTICAL BLANKET INSULATION

- A Acceptable Manufacturers:
  - 1. Johns-Manville, 800/654-3103; [www.jm.com](http://www.jm.com).
  - 2. Knauf Fiber Glass; 800/825-4434; [www.knaufinsulation.us](http://www.knaufinsulation.us).
  - 3. Owens-Corning, 800/GET-PINK; [www.owenscorning.com](http://www.owenscorning.com).
  - 4. Accepted substitute in accordance with Section 01 25 00.
- B Sound Control Blankets for Partitions: ASTM C665, Type 1, unfaced.
  - 1. Acceptable Products:
    - a. Knauf EcoBatt; [www.ecobatt.us](http://www.ecobatt.us).
    - b. Manville Sound Control Batts.
    - c. Accepted substitute in accordance with Section 01 25 00.
  - 2. Material: Formaldehyde-free inorganic fiber glass bonded with thermoset resin.
  - 3. Thickness: 3½ inches thick unless otherwise indicated.
  - 4. Width: 16 inches or 24 inches to match partition wall stud spacing or joist spacing as applicable and as indicated.
  - 5. Surface Burning Characteristics: ASTM E84.
    - a. Flame Spread: Maximum 25.
    - b. Smoke Developed: Maximum 50.
- C Acoustical Batts for Ceilings: ASTM C665, Type 1, unfaced.
  - 1. Acceptable Manufacturers and Products:
    - a. Owens Corning Sonobatts Insulation.
    - b. Accepted substitute in accordance with Section 01 25 00.
  - 2. Size: Sized to fit 2 foot by 4 foot ceiling panel system.
  - 3. Thickness: 6¼ inches.
  - 4. Surface Burning Characteristics: ASTM E84.

- a. Flame Spread: Maximum 10.
- b. Smoke Developed: Maximum 10.

**PART 3 EXECUTION**

**3.01 INSTALLATION, GENERAL**

- A Comply with manufacturer's instructions for particular conditions of installation in each case.
- B Install materials to comply with thermal and sound control requirements noted on Drawings.
- C Unfaced Insulation: Not allowed in exposed applications where there is a potential for skin contact and irritation.

**3.02 ACOUSTICAL BLANKET INSTALLATION IN PARTITIONS**

- A Batts: Friction-fit in place until interior finish is applied. Install batts to fill entire stud cavity. Place in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within partitions and tight to items passing through partitions.
  - 1. Stud Cavity Heights Up To 8 Feet: Cut lengths to friction-fit against floor and ceiling tracks or plates.
  - 2. Stud Cavity Heights Greater Than 8 Feet: Provide supplemental support as required to hold batts in place until the interior finish is applied.

**3.03 ACOUSTICAL BLANKET INSULATION INSTALLATION OVER CEILINGS**

- A Sound Attenuation Blankets Over Ceilings:
  - 1. Cover ceiling panels for 2 feet each side of acoustically insulated partitions.
- B Sound Attenuation Blankets Over Acoustical Ceilings: Lay batts on top of the ceiling panel and suspension system between tees. Fit batts tightly together.
  - 1. Blankets at Light Fixtures: Comply with National Electrical Code. Do not install insulation over or within 3 inches (76 mm) of recessed light fixtures, unless approved insulated ceiling (IC) lighting fixtures are used.

**END OF SECTION**



**SECTION 09 91 23  
INTERIOR PAINTING**

**PART 1 GENERAL**

**1.01 SUMMARY**

**A Section Includes:**

1. Paint all new or patched interior surfaces.
2. Interior painting.
3. Touch up painting of existing surfaces abraded or otherwise damaged by construction operations.
4. Painting acoustical ceiling grid where noted on Drawings.
5. Includes:
  - a. Surface preparation, priming and field application of finish coat(s) to all exterior surfaces not specifically excluded.
  - b. Surface preparation, priming and field application of finish coat(s) to all interior surfaces not specifically excluded.
  - c. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

**B Exclusions:** In addition to material obviously not requiring paint such as glass, floor, tile, etc. do not paint or finish:

1. Surfaces indicated by the Finish Schedule to remain unfinished.
2. Factory finished surfaces unless otherwise specified.
3. Concealed surfaces.
4. Operating parts.
5. Labels.
6. Existing surfaces not included in the Work.

**C Related Requirements:**

1. Section 01 61 65 - Low-Emitting Material Requirements
2. Primer for Structural Steel: Section 05 12 53 Miscellaneous Structural Steel.
3. Primer for Metal Fabrications: Section 05 50 00 Metal Fabrications.
4. Piping Identification: Section 22 05 53 Identification For Plumbing Piping And Equipment.

**1.02 REFERENCES**

**A Definitions:**

1. Terminology: ASTM D16-12 – Standard Terminology for Paint, Related Coatings, Materials, and Applications 2016.
2. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
3. Coat: An application of paint or coating that is allowed to dry prior to subsequent application.
4. Sheen Terms:
  - a. Flat: Lusterless or matte finish with a gloss range below 15 when measured at a 85-degree meter.
  - b. Eggshell: Low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
  - c. Semigloss: Medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
  - d. Full Gloss: High-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

**1.03 ACTION SUBMITTALS**

- A Procedures:** Submit for review, acceptance and return in accordance with Section 01 33 00.

- B Material List: Immediately after award of the contract submit a letter listing the manufacturer and product name of each different paint and coating material for use on the Project. Do not order materials before Material List has been accepted by the Architect.
- C Paint Samples: If requested by Architect, prepare and submit paint samples. Remake samples until accepted.

#### 1.04 MAINTENANCE MATERIALS SUBMITTALS

- A Extra Paint: At the completion of painting, deliver to the Owner one full gallon of each paint color and type used along with the color number or formula for each type.
  - 1. Epoxy and high performance coatings are not included.

#### 1.05 QUALITY ASSURANCE

- A Qualifications:
  - 1. Applicator Qualifications: Applicator shall have minimum 5 years' experience and shall have successfully completed commercial work of similar scale to this Project.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A General Requirements: Comply with Section 01 60 00.
- B Delivery and Acceptance Requirements: Deliver materials required for painting in unbroken packages bearing the brand and name of manufacturer. Order materials sufficiently in advance to be on the job when needed and deliver at the building in sufficient quantities so the work will not be delayed. No claim by the Contractor concerning unsuitability of any material specified or his inability to produce first-class work with the same, will be entertained unless such claim is made, in writing, with the material list submittal.
- C Storage and Mixing: Painter will be assigned a room or space in which to mix or store material. Provide galvanized mixing pans for this paint room or space in which paints shall be mixed. No mixing of paint shall be done except in these pans. Empty containers bearing the name or brand of any manufacturer shall not be brought upon the premises for mixing of paint unless labels are canceled and containers are closely marked as to contents.
  - 1. Inspection: The paint storage area shall be open for periodic inspection by the Architect to ensure only approved materials are being used.

#### 1.07 AMBIENT CONDITIONS

- A Apply coating under following conditions only.
  - 1. Temperature of Air: Between 50 and 100 degrees F.
  - 2. Temperature of Substrate: Between 50 and 100 degrees F and above dew point.
  - 3. Lighting: Maintain 80 foot candles minimum on surfaces to be finished.

### **PART 2 PRODUCTS**

#### 2.01 MANUFACTURERS

- A Basis of Design Paint Manufacturer: See Finish Legend on Drawings.
  - 1. Sherwin-Williams Company; [www.sherwin-williams.com](http://www.sherwin-williams.com).
- B Other Acceptable Manufacturers: The best quality materials as manufactured by any of the following manufacturers will be acceptable: (Paint Only):
  - 1. For Brush, Roller or Spray Work:
    - a. Benjamin Moore & Co.; [www.benjaminmoore.com](http://www.benjaminmoore.com).
    - b. Dunn-Edwards Corporation; [www.dunnedwards.com](http://www.dunnedwards.com).
    - c. Glidden Professional Brand of PPG Architectural Coatings; [www.gliddenprofessional.com](http://www.gliddenprofessional.com).
    - d. Kelly-Moore Paint Company; [www.kellymoore.com](http://www.kellymoore.com).
    - e. PPG Pittsburgh Paints; [www.ppgpittsburghpaints.com](http://www.ppgpittsburghpaints.com).
    - f. Pratt & Lambert, Inc.; [www.prattandlambert.com](http://www.prattandlambert.com).
  - 2. Touch-up Paint for Acoustical Tile and Panel Ceilings:
    - a. Armstrong World Industries; [www.armstrong.com](http://www.armstrong.com) – SuperCoat.

- C Substitution Requests: Required for all manufacturers and products not named as Basis of Design or as Acceptable Manufacturer.
  - 1. Requests for substitutions must be on company letterhead and signed by an authorized representative of the manufacturer. Letters from sales representatives or retailers will not be acceptable.
  - 2. Submissions: Submit in accordance with Section 01 25 00.

## 2.02 REGULATORY REQUIREMENTS

- A Regulatory Requirements: Product shall be certified to meet the following.
  - 1. Volatile Organic Content (VOC): Paint and coating materials shall not exceed VOC content limitations of all applicable regulations, when thinned to manufacturer's maximum recommendation.

## 2.03 MATERIALS

- A Quality: All products not specified by name shall be "best grade" or "first line" products or acceptable manufacturers. See Part 3 Execution for materials required for this Project. Where possible, materials shall be of a single manufacturer.
- B Volatile Organic Content (VOC): In addition to meeting all applicable regulations, paint and coating materials shall be certified to not exceed following VOC content limitations when thinned to manufacturer's maximum recommendation.
  - 1. Architectural Paints, Coatings, and Primers Applied to Interior Walls and Ceilings:
    - a. Flat: VOC content less than 50 grams/liter.
    - b. Non-Flats: VOC content less than 150 grams/liter.
    - c. Eggshell Interior Finish Coat: VOC content less than 150 grams/liter.
  - 2. Anti-Corrosive and Anti Rust Paints Applied to Interior Ferrous Metal Substrates: VOC content less than 250 grams/liter.
  - 3. Epoxy: Waterborne epoxy; maximum VOC content 200 grams/liter.
  - 4. Clear Wood Finishes, Floor Coatings, Stains, Sealers, and Shellacs Applied to Interior Elements:
    - a. Clear Wood Finishes: Varnish VOC content less than 350 grams/liter; lacquer VOC content less than 550 grams/liter.
    - b. Floor Coatings: VOC content less than 100 grams/liter.
    - c. Sealers: Waterproofing sealers VOC content less than 250 grams/liter; sanding sealers VOC content less than 275 grams/liter; all other sealers VOC content less than 200 grams/liter.
    - d. Stains: VOC content less than 250 grams/liter.
  - 5. Paint Strippers – Low-Emitting: Shall not contain methylene chloride. Avoid products containing methanol and trichloroethane.
- C Colors: See Finish Legend on Drawings. If materials of other manufacturers are used, colors must match those selected.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A Verification of Conditions: Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into an acceptable condition through preparatory work as included under Preparation.
- B Report unsatisfactory conditions to the General Contractor in writing with copy to the Architect.
- C Acceptance: Beginning of application means acceptance of existing surfaces.

### 3.02 PREPARATION

- A General:
  - 1. Spaces: Clean before finishing is started. Do not finish rooms or spaces where rubbish has accumulated or while rubbish is being removed. Finishing not allowed in dusty rooms.

2. Sand finishes on wood and metal surfaces between coats to ensure smoothness and adhesion of subsequent coats. Use extra fine sandpaper to avoid cutting the edges when sanding. Apply putty or spackling compound after surfaces are primed and primer is dry. Bring material flush with adjoining surfaces.
3. Existing Surfaces: If the surfaces are not in proper shape for painting or finishing, repair, rebuild or refinish before proceeding with the work. Be responsible for any poor work caused by improper surfaces. Surfaces shall be dry, clean and smooth before starting work. Fill cracks, holes or checks full and make smooth before finish is applied to surfaces. Fill any cracks, etc., which occur after walls are sized.

**B Metals:**

1. Ferrous Metal: Remove foreign material, rust and mill scale from unprimed metal.
  - a. Wire brush or sand damaged or rusted areas to bright metal.
  - b. Remove grease and other foreign materials with mineral spirits.
  - c. Dust clean.
2. Shop Primed Metals: Touch-up shop primed metals with a primer similar to the existing. Sand shop primer on hollow metal work immediately before painting to remove grease and dirt film from surfaces.
3. Zinc Coated Metal (Galvanized Surfaces): Solvent clean with mineral spirits or other acceptable solvent in accordance with SSPC-SP1 to remove all residue oil, grease or other contamination. Prime as specified.
4. Non-ferrous Metals: Clean with lacquer thinner.

**C Gypsum Board:** Verify surfaces are clean and dry, with all nail heads set and embedded in joint compound, and with joints sanded smooth. Remove all dust prior to painting.

**D Protection:**

1. Furnish and lay drop cloths or mask off areas where finishing is being done to protect floors and other work from damage during the execution of work.
2. Remove items which are not to be coated from surfaces which are to be coated. Reinstall items after completion of coating application. Include mechanical grilles and factory finished items.
3. Where it becomes necessary to remove temporary coverings placed by others, replace same in proper manner.
4. Remove empty cans, oily rags and waste from the building every night. Do not allow to accumulate.
5. Damage to Work of Others: Be responsible for any damage done to the work of other trades, repairing same to the satisfaction of the Architect. Replace any materials damaged to such an extent that they cannot be restored to their original condition.

**3.03 APPLICATION**

**A Painting and Staining, General:** Apply primer and two finish coats unless otherwise noted.

1. The application of the first coat does not relieve the applicator of responsibility for the base.
2. Do not apply any coats on either damp or wet surfaces and in no case until the preceding coat is dry and hard.

**B Primer:** Apply as many coats as necessary to produce a uniform substrate appearance. Do not exceed manufacturer's recommended coverage rate.

1. Tint primers to match finish coat.
2. Allow to dry prior to application of subsequent coats.
3. Sand primer with 100 grit or finer sandpaper. Remove dust.

**C Application of Finish Coats:** Spread materials evenly without runs or sagging of materials and thoroughly brush out.

1. Second and third coats shall not be applied until preceding coat is dry.

2. Sand work between coats.
  3. Colors: Each finish coat shall be color as selected by Architect.
- D Roller Application: Where paint or enamel is rolled on, use fine nap roller so nearly flat or orange peel texture is obtained.
1. Painting Existing Acoustical Ceiling Suspension Grid: Paint exposed surfaces of grid by spray, brush or roll coating. If necessary to achieve complete hiding and finish, apply in two coats.
- E Spray Application:
1. Metals: Apply paint to all metals by spray application method.
  2. Acoustical Tiles and Panels: Apply paint to acoustical tiles and panels by spray application.
    - a. Existing Surfaces: Do not apply any coats on either damp or wet surfaces and in no case until the preceding coat is dry and hard.
    - b. Apply paint with a stream directed perpendicularly to the surface of the material. Apply to produce uniform coating that does not close the perforations or fissures in the material.
    - c. Apply in single coat unless second coat is required to hide stains. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

#### 3.04 MISCELLANEOUS REQUIREMENTS

- A Mechanical Piping and Ductwork: Wherever insulated pipe or ductwork occurs in rooms where walls are finished, cover canvas jacket with one coat sealer and two coats flat wall paint. Wherever uninsulated piping or ductwork occurs in rooms where walls are finished or elsewhere as called for, finish pipes as called for under ferrous zinc coated, or factory primed metals. See Division 22 for identification markings.
- B Electrical Wiremold: Paint to match wall on which installed.

#### 3.05 CLEANING

- A Do not remove rubbish while finish is fresh. Surfaces: Dry and clean.
- B Clean-up Materials: Non-abrasive mild detergent, cellulose sponge and potable water.
- C Clean up overspray and spills.
- D Remove masking.
- E Allow at least 7 days after application before washing.
- F Final Cleaning: At the completion of work, remove all surplus materials, staging, rubbish; clean off all paint, varnish, stains from floors, glass, walls, hardware; and leave the premises in clean condition.

#### 3.06 PROTECTION

- A Protect coating from damage.
- B Touch up and repair coatings damaged by Work.

#### 3.07 COATING SYSTEM - INTERIOR

- A General:
1. Paint and coating systems shall meet following scheduled requirements as a minimum.
  2. Delete primer when re-coating existing surfaces.
- B Ferrous, Zinc Coated or Factory-Primed Metals - Painted:

First Coat:	Factory Primer Coat or Suitable Primer
Second Coat:	Enamel Undercoat
Third Coat:	Semi-Gloss Enamel

C Hollow Metal Frames - Painted:

First Coat: Factory-Prime Coat (Sanded)  
Second Coat: Enamel Undercoat  
Third Coat: Semi-Gloss Enamel

D Gypsum Board Walls - Painted:

First Coat: Suitable Primer  
Second Coat: Latex Enamel, Eggshell  
Third Coat: Latex Enamel, Eggshell

E Gypsum Board Ceilings and Soffits - Painted:

First Coat: Suitable Primer  
Second Coat: Second Coat: Latex Enamel, Gloss  
Third Coat: Latex Enamel, Gloss

**END OF SECTION**

## SECTION 10 26 00

### WALL AND DOOR PROTECTION

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section Includes:
  - 1. Corner guards.
  - 2. Crash rails for wall protection.
  - 3. Plastic, impact-resistant, wall protection panels.
- B. Related Requirements:
  - 1. Low-Emitting Material Requirements: Section 01 61 65.

##### 1.02 REFERENCES

- A. General Requirements: Refer to Section 01 42 00.
- B. Abbreviations and Acronyms:
  - 1. PETG: Polyethylene terephthalate glycol-modified.

##### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation with wall construction and finishes, including concealed blocking or anchoring devices, installation of wall base, and painting.
- B. Sequencing: Complete all finishing operations, including painting, before beginning installation of wall and door protection materials.

##### 1.04 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Manufacturer's current product data sheets describing each system component and installation accessory to be supplied with all selected options clearly identified, basic uses, composition and materials, physical properties, precautions and limitations, applicable standards, approvals, and general installation procedures.
- C. Shop Drawings: Submit shop drawings indicating locations, extent and installation details. Show methods of attachment to adjoining construction.
- D. Samples:
  - 1. Samples for Verification:
    - a. Corner Guards, Crash Rails, and Chair Rails: Submit 12 inch long full size profiles of each product type illustrating component design, configuration, color, and finish.
    - b. Wall Protection Panels: Submit 8 inch square samples for verification of each product type and color indicated.

##### 1.05 INFORMATIONAL SUBMITTALS

- A. Procedures: Submit for information and verification in accordance with Section 01 33 00.

- B. Manufacturer's Instructions:
  - 1. Submit Manufacturer's installation instructions.
    - a. Include installation methods for each type of substrate indicated.
    - b. Maintain one additional copy on site until completion of installation.

#### 1.06 CLOSEOUT SUBMITTALS

- A. Submit the following for Project record in accordance with Section 01 78 00:
  - 1. Operating and Maintenance Data: Maintenance data for wall protection system components for inclusion in the operating and maintenance manuals.
    - a. Include cleaning and maintenance instructions for Owner's information.
  - 2. Warranty: Submit manufacturer's standard 5-year warranty.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. General Requirements: Comply with Section 01 60 00 and with Manufacturer's recommendations.
- B. Delivery and Acceptance Requirements: Deliver materials to the Project site in unopened original factory packaging clearly labeled to show manufacturer.
- C. Storage and Handling Requirements:
  - 1. Store materials in original, undamaged packaging in a cool, dry place out of direct sunlight and exposure to the elements. Maintain a minimum room temperature of 40 degrees F and a maximum of 100 degrees F.
  - 2. Store materials flat.

#### 1.08 AMBIENT CONDITIONS

- A. Acclimate materials in an environment between 65 degrees F and 75 degrees F for at least 24 hours prior to beginning the installation.
- B. Temperature at the time of installation shall be between 65 degrees F and 75 degrees F and be maintained for at least 48 hours after the installation.

### **PART 2 PRODUCTS**

#### 2.01 REGULATORY REQUIREMENTS

- A. Assemblies: Conform to all applicable codes including CBC.
- B. Product shall comply with California 01350 specification for low VOC.

#### 2.02 CORNER GUARDS

- A. Basis of Design Manufacturer and Products:
  - 1. Manufacturer: Construction Specialties, Inc.; [www.c-sgroup.com](http://www.c-sgroup.com).
  - 2. Model: Acrovyn SSM-25 Series.
- B. Description: Snap-on covers of Class 1 fire-rated resilient material, minimum 0.078 inch thick, free-floated over continuous retainer, surface-mounted and anchored to wall at 20 inches on center maximum; molded end caps color matched to covers.
- C. Nominal Size: 2-inches by 2-inches by 4 feet high.



- D. Fabrication:
  - 1. Fabricate components with tight joints, corners, and seams.
  - 2. Pre-drill holes for attachment.
  - 3. Form end trim closure by capping and finishing smooth.
- E. Accessories: Provide attachment accessories as recommended by corner guard manufacturer.
  - 1. Fasteners: Bugle head screws.

## 2.04 CRASH RAILS

- A. Basis of Design Manufacturer and Products:
  - 1. Manufacturer: Construction Specialties, Inc.; [www.c-sgroup.com](http://www.c-sgroup.com).
  - 2. Upper Crash Rail Product: Acrovyn 4000 Model SCR-50N.
  - 3. Lower Crash Rail Product: Acrovyn 4000 Model SCR-80N.
  - 4. Color: See Finish Legend on Drawings.
- B. Engineered PETG Crash Rail Assembly: Surface mounted assembly consisting of standard aluminum clips with snap-on PETG cover and continuous integral shock absorbing cushions.
  - 1. End Caps and Corners:
    - a. Mechanically fastened with concealed fasteners.
    - b. Color matched.
    - c. Removable.
    - d. Provide 90 degree outside corners where indicated.
  - 2. Upper Crash Rail Nominal Height: 5 inches.
  - 3. Lower Crash Rail Nominal Height: 8 inches.
  - 4. Upper Crash Rail Wall Offset: 1-1/16 inches.
  - 5. Lower Crash Rail Wall Offset: 1-3/8 inches.
  - 6. Assembly to mount to wall with 1-inch wide aluminum mounting clips.
- C. Texture: Shadowgrain.

## 2.05 PROTECTIVE WALL COVERING

- A. Basis of Design Manufacturer and Product: See Finish Legend on Drawings.
  - 1. Construction Specialties, Inc. – Acrovyn.
  - 2. Color, Texture and Joint Detail: As indicated on Finish Legend.
- B. Description: Vinyl/acrylic panels of gage indicated on Finish Legend.
  - 1. Size: Height as indicated by length required in one piece.
- C. Accessories and Trim: Manufacturer's standard vinyl/acrylic alloy moldings and trim.
- D. Adhesive: Contact type as recommended by the manufacturer and complying with Southern California VOC regulations and Section 01 61 65.

## 2.06 PERFORMANCE

- A. Fire Performance Characteristics: Provide engineered wall protection system components with UL label indicating that they are identical to those tested in accordance with ASTM E84 for Class A/1 characteristics listed below:
  - 1. Flame Spread: 25 or less.
  - 2. Smoke Developed: 450 or less.
- B. Impact Strength: Provide wall protection units that have been tested in accordance with the applicable provisions of ASTM F476 and ASTM B221.

- C. Chemical and Stain Resistance: Provide wall protection system components with chemical and stain resistance in accordance with ASTM D543.
- D. Color Match: Provide wall protection components that are color matched in accordance with the following:
  - 1. Delta Ecmc of no greater than 1.0 using CIE Lab color space.

## 2.07 MATERIALS

- A. Extruded PETG Component Material: High-impact polyethylene terephthalate glycol-modified, nominal 0.078 inch thickness.
- B. Absorption Cushion: Re grind PETG, PVC-free.
- C. Extruded Aluminum: 6063-T6 alloy, nominal 0.075 inch thickness. Minimum strength and durability properties as specified in ASTM B221.

## 2.08 FABRICATION

- A. Fabricate wall protection systems to comply with requirements indicated for design, dimensions, detail, finish and member sizes.
- B. Factory form radius for installation on curved walls where indicated.

## 2.09 ACCESSORIES

- A. Attachment hardware shall be appropriate for wall conditions.
- B. Fasteners: All fasteners to be non-corrosive and compatible with aluminum components.
  - 1. All necessary fasteners to be supplied by the manufacturer.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verification of Conditions: Comply with Section 01 71 16.
  - 1. Existing Conditions: Verify of existing conditions before starting work. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
- B. Notification: Notify General Contractor of unsatisfactory conditions in writing with copy to Architect.
  - 1. Report prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
- C. Acceptance: Beginning of work means acceptance of existing conditions by installer.

### 3.02 PREPARATION

- A. Surface Preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.
  - 1. Surfaces to Receive Wall Panels: All wall surfaces to be smooth, level, clean, dry and free of any irregularities to provide a good adhesive grip and smooth application of wall panels.

- B. Provide ventilation to disperse fumes during application of adhesive. Allow no containers of adhesive to be opened until all potential sources of flame or spark have been shut down or extinguished and until warning signs have been posted.

### 3.03 INSTALLATION

- A. General: Install in accordance with manufacturer's published instructions and recommendations.
  - 1. Use only approved mounting hardware and adhesives.
  - 2. Locate all components firmly into position, level and plumb.
- B. Corner Guard Installation: Install over corners, square and plumb, secured rigidly in position.
  - 1. Butt bottom of corner guard to top of base; with top of corner guard 4 feet above finish floor.
- C. Crash Guard Installation:
  - 1. Adjust installed end caps as necessary to ensure tight seams.
  - 2. Where splices occur in horizontal runs, splice retainer and rail at different locations along the run.
- D. Protective Wall Panel Installation:
  - 1. Adhesive: Comply with manufacturer's instructions regarding method of application, spread rate, drying time, open time and temperature and humidity limitations.
  - 2. Panels: Align and plumb the first sheet before allowing the glue lines to come together, then apply the sheet slowly from one side to the other to expel air. Roll uniformly with hard rubber roller.
  - 3. Install rigid sheets beveled at seams and chemically sealed. Butt adjoining panels tight, in straight, even line. Install panels without top cap, vertical divider bars, inside corner trim, or other joint accessories and trim unless otherwise detailed on Interior Design Drawings.
  - 4. Immediately remove any adhesive from face of panels using solvent recommended by panel manufacturer. Keep faces clean during application.
  - 5. Trim: Install trim at all exposed edges and outside corners.

### 3.04 CLEANING

- A. Immediately upon completion of installation, clean material in accordance with manufacturer's recommended cleaning method.
- B. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.

### 3.05 PROTECTION

- A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION



**SECTION 10 28 13  
TOILET ACCESSORIES**

**PART 1 GENERAL**

1.01 SUMMARY

A Section Includes:

1. Toilet room accessories as indicated and specified.

1.02 REFERENCES

A Reference Standards: Comply with the following as applicable:

1. United States Department of Justice – 2010 ADA Standards for Accessible Design, September 15, 2010; available at [www.ada.gov/ADAStandards\\_index.htm](http://www.ada.gov/ADAStandards_index.htm).

1.03 ACTION SUBMITTALS

A Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.

B Product Data: Submit manufacturer's current product literature.

**PART 2 PRODUCTS**

2.01 TOILET ACCESSORIES

A Basis of Design Manufacturers and Products: See Toilet Accessories Schedule on the Drawings.

1. Bobrick Washroom Equipment, Inc.; [www.bobrick.com](http://www.bobrick.com).

**PART 3 EXECUTION**

3.01 EXAMINATION

A Verification of Conditions: Comply with Section 01 71 16.

1. Existing Conditions:

- a. Verify solid blocking in partitions and walls as required for proper support of toilet accessories.

B Notification: Notify General Contractor of unsatisfactory conditions in writing with copy to Architect.

C Acceptance: Beginning of work means acceptance of existing conditions by installer.

3.02 INSTALLATION

A Fasten accessories rigidly and securely to walls using methods and materials recommended by manufacturer.

B Locate and mount at heights complying with local, state and ADA Standards.

3.03 ADJUSTMENT

A Before final inspection, inspect each accessory installation for rigid and secure installation. Take action necessary for rigid and secure installations.

**END OF SECTION**

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## SECTION 10 44 00

### FIRE PROTECTION SPECIALTIES

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Section Includes:
  - 1. Fire extinguisher cabinets.
  - 2. Fire extinguishers.
- B. Related Requirements:
  - 1. Wood Blocking: Section 06 10 00 Rough Carpentry.

##### 1.02 REFERENCES

- A. Reference Standards: See Section 01 42 00. Comply with the following.
  - 1. NFPA 10 – Standard for Portable Fire Extinguishers, 2018 Edition.

##### 1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Indicate types and locations.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design Fire Extinguisher Cabinet Manufacturer and Product: Larsen's Manufacturing Company - Model 2409-6R.
- B. Other Acceptable Fire Extinguisher Cabinet Manufacturers:
  - 1. JL Industries, Inc., Activar Construction Products Group; [www.activarcpg.com/jl-industries/](http://www.activarcpg.com/jl-industries/)
  - 2. Larsen's Manufacturing Company
  - 3. Potter Roemer, division of Acorn Engineering Company.
- C. Acceptable Fire Extinguisher Manufacturers:
  - 1. Ansul Incorporated.
  - 2. JL Industries, Inc., Activar Construction Products Group; [www.activarcpg.com/jl-industries/](http://www.activarcpg.com/jl-industries/)
  - 3. Larsen's Manufacturing Company.
  - 4. Potter Roemer, division of Acorn Engineering Company.

##### 2.02 FIRE EXTINGUISHER CABINETS

- A. Description: Vertical Duo-panel door style with semi-recessed 18 gage steel box.
  - 1. Pull handle to open door.
  - 2. Provide fire rated cabinets where located in fire rated partitions.
- B. Factory Finish: Powder coat, white.

## 2.03 FIRE EXTINGUISHERS

- A. Type and Capacity: 10 pound Multi-Purpose A-B-C type with pressure gage.

## **PART 3 EXECUTION**

### 3.01 INSTALLATION

- A. Cabinets: Install cabinets according to manufacturer's instructions.
  - 1. Provide necessary wood blocking.
  - 2. Field locate as directed by fire department and Architect.
- B. Extinguishers: Install in cabinets or on wall brackets and leave fully charged.

END OF SECTION



## SECTION 11 70 00

### HEALTHCARE EQUIPMENT

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Products Installed But Not Furnished Under This Section:
  - 1. Contractor shall install Owner-furnished equipment where indicated in the Equipment Schedule.
  - 2. Medical equipment and furnishings indicated, keynoted, and indexed on Drawings.
- B. Related Requirements:
  - 1. Equipment Schedule and Drawings apply to Work of this Section.
  - 2. Owner-Furnished Products: Section 01 64 00.
  - 3. Electrical Connections: Division 26 Electrical.

##### 1.02 PRE-INSTALLATION CONFERENCE

- A. The Design/Builder will conduct pre-installation conference in accordance with Section 01 31 19.
- B. Attendance Required: Contractor, manufacturer's representative, and installer.
- C. Agenda: Discuss and agree upon acceptable substrate and mounting conditions, preparatory work, utility connections, and methods of installation.

##### 1.03 SEQUENCING

- A. Prior to fabrication of mounting plates, furnish mounting plate templates to trades installing structure to support mounting plates.
- B. Install mounting plates to structural supports prior to covering-up by subsequent construction operations.

##### 1.04 DATA TO BE FURNISHED BY SEPARATE VENDORS FOR COORDINATION

- A. Product Data: Furnished by Owner for each Contractor-installed item.
  - 1. Include data to indicate standard mounting and utility connection details.
  - 2. Include information for factory finishes, hardware, glass, sealants, accessories and other required components.
  - 3. Include wiring diagrams and rough-in requirements for items requiring electrical connections.
- B. Shop Drawings: Furnished by Owner for non-standard custom-fabricated items to be installed by Contractor.
  - 1. Will indicate typical layout including dimensions, mounting locations and sizes, service accesses, utility connections, mounting sequences, and division of installation responsibilities.
  - 2. Will include detail drawings of non-standard mounting details and utility connections.
  - 3. Will include detail drawings of special accessory components not included in manufacturer's product data.

- C. Informational Submittals: Submit following packaged separately from other submittals:
  - 1. Manufacturer's Instructions: Manufacturer's printed installation instructions will be furnished by Owner.

#### 1.05 CLOSEOUT SUBMITTALS

- A. Submit following in accordance with Section 01 78 00.
  - 1. Operation and Maintenance Data: Manufacturer's printed, recommended operation and maintenance data when furnished with equipment.

### **PART 2 PRODUCTS**

#### 2.01 OWNER-FURNISHED PRODUCTS

- A. See Equipment Schedule on Drawings and cut sheets in Appendix No. 1.

### **PART 3 EXECUTION**

#### 3.01 EXAMINATION

- A. Verification of Conditions: Examine conditions in accordance with Section 01 73 19.
  - 1. Verify utility connections are installed.
  - 2. Verify mounting brackets, plates, and supports are installed.

#### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Install equipment plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction.
- C. Refer to Equipment Schedule for:
  - 1. Mounting heights.
  - 2. Mounting and anchoring details.

#### 3.03 ADJUSTING

- A. Adjust parts for smooth, uniform operation.
- B. Touch-up minor surface coating damaged during installation; replace damaged units as directed by Architect.

#### 3.04 CLEANING

- A. Remove protective covering from pre-finished items.
- B. Clean as recommended by manufacturer. Do not use materials or methods that may damage finish or surrounding construction.

END OF SECTION

**SECTION 12 36 00  
COUNTERTOPS**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A Countertops for architectural cabinet work.
- B Countertops for manufactured casework.

1.02 RELATED REQUIREMENTS

- A Section 06 41 00 - Architectural Wood Casework.

1.03 REFERENCE STANDARDS

- A ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use 2016.
- B ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- C AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014, with Errata (2018).
- D AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).
- E NEMA LD 3 - High-Pressure Decorative Laminates 2005.

1.04 SUBMITTALS

- A See Section 01 33 00 - Submittal Procedures for submittal procedures.
- B See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- C Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Specimen warranty.
- D Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- E Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- F Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

- A Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B Quality Certification:
  - 1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  - 2. Provide designated labels on shop drawings as required by certification program.
  - 3. Provide designated labels on installed products as required by certification program.
  - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A Store products in manufacturer's unopened packaging until ready for installation.
- B Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

## **PART 2 PRODUCTS**

### **2.01 COUNTERTOPS**

- A Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
  - 1. Laminate Sheet, Type [ ]: NEMA LD 3, Grade HGS, 0.048 inch ( 1.2 mm ) nominal thickness.
    - a. Manufacturers:
      - 1) Panolam Industries International, Inc; Pionite Standard HPL: [www.panolam.com/#sle](http://www.panolam.com/#sle).
      - 2) Wilsonart; HPL: [www.wilsonart.com/#sle](http://www.wilsonart.com/#sle).
    - b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
    - c. Finish: Matte or suede, gloss rating of 5 to 20.
    - d. Surface Color and Pattern: As indicated on drawings.
  - 2. Exposed Edge Treatment: Molded rubber edge with T-spline, sized to completely cover edge of panel.
    - a. Color: As indicated on drawings.
  - 3. Back and End Splashes: Same material, same construction.
  - 4. Fabricate in accordance with manufacturer's standard requirements.

### **2.02 MATERIALS**

- A Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- B Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch ( 12 mm ) by 1/2 inch ( 12 mm ).
  - 1. Color: As indicated on drawings.
- C Joint Sealant: Mildew-resistant silicone sealant, white.

### **2.03 FABRICATION**

- A Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
  - 1. Join lengths of tops using best method recommended by manufacturer.
  - 2. Fabricate to overhang fronts and ends of cabinets 1 inch ( 25 mm ) except where top butts against cabinet or wall.
  - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
  - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
  - 2. Height: 4 inches ( 102 mm ), unless otherwise indicated.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A Do not begin installation until substrates have been properly prepared.
- B If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

### **3.02 PREPARATION**

- A Clean surfaces thoroughly prior to installation.

- B Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.03 INSTALLATION

- A Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch ( 16 mm ).
- C Seal joint between back/end splashes and vertical surfaces.
  - 1. Where indicated use rubber cove molding.
  - 2. Where applied cove molding is not indicated use specified sealant.

### 3.04 TOLERANCES

- A Variation From Horizontal: 1/8 inch in 10 feet ( 3 mm in 3 m ), maximum.
- B Offset From Wall, Countertops: 1/8 inch ( 3 mm ) maximum; 1/16 inch ( 1.5 mm ) minimum.
- C Field Joints: 1/8 inch ( 3 mm ) wide, maximum.

### 3.05 CLEANING

- A Clean countertops surfaces thoroughly.

### 3.06 PROTECTION

- A Protect installed products until completion of project.
- B Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION**

**SECTION 21 13 13  
FIRE PROTECTION**

**PART 1 GENERAL**

1.01 GENERAL AND SPECIAL CONDITIONS

- A. The Work under this Contract necessary for and incidental to the execution and completion of all Work indicated in the Contract Documents for construction of:
- B. General and special conditions apply to the work in this section.
- C. The Contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete fire protection system, with said systems being made ready for operation in accordance with the requirements of the Authorities Having Jurisdiction. The purpose of Owner furnished specifications is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust, and make operable. The omission by the Owner of any necessary system component as required by the Authorities Having Jurisdiction, in the specifications shall not relieve the Contractor of the responsibility for providing such necessity, without additional cost to the Owner. The Contractor shall visit the site before submitting his bid and shall examine all existing physical conditions that may be material to the performance of his work. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of error, omission, discrepancy or lack of clarity shall be promptly identified to the Owner, Architect, and Engineer for clarification prior to the bid due date.
- D. The Contractor shall provide all devices and equipment required by these specifications. Under no circumstances will the Contractor delete any equipment or devices without the written directive of the Owner.

1.02 SYSTEM ABBREVIATIONS AND DEFINITIONS

- A. AHJ – Authority Having Jurisdiction (OSHPD).
- B. Approved – Unless otherwise stated, materials, equipment or submittals approved by the Engineer.
- C. ANSI – American National Standards Institute.
- D. Architect – Sfeir Architects
- E. ASTM – American Society for Testing and Materials.
- F. AWS – American Welding Society.
- G. AWWA – American Water Works Association.
- H. Concealed – Where used in connection with installation of piping or conduit and accessories, shall mean, “Hidden from sight” as in shafts, furred spaces, in soffits or above suspended ceilings.
- I. Contractor – The Company awarded the prime contract for this work and any of its subcontractors, vendors, suppliers, or fabricators.
- J. Engineer – JENSEN HUGHES.
- K. Exposed – Where used in connection with installation of piping or conduit and accessories, shall mean “visible” or “not concealed.”
- L. FM – FM Global.

- M. FM Approved – Materials or equipment approved by FM Global and included in the most recent edition of the FM Approval Guide.
- N. Furnish – Supply materials.
- O. GPM – Gallons per minute.
- P. Install – Install materials, mount, and connect equipment or assemblies.
- Q. IRI – Industrial Risk Insurers.
- R. ISO – Insurance Services Office.
- S. NFPA – National Fire Protection Association.
- T. Owner – Tri-City Medical Center.
- U. Provide – Furnish, install, and connect.
- V. PSI – Pounds per square inch.
- W. QR – Quick-Response Sprinkler.
- X. Remove – Remove material and equipment and restore surface.
- Y. UL – Underwriters Laboratories, Inc.
- Z. UL Listed – Materials or equipment by Underwriters Laboratories and included in the most recent edition of the UL Fire Protection Equipment Directory.

### 1.03 SCOPE OF WORK

- A. Provide complete fire protection system for the MRI Remodel as outlined in the project specifications and shown on the permit drawings, including all labor, materials, permits, shop drawings and hydraulic calculations needed to furnish and install a complete and functional automatic sprinkler system, and all of the following:
  1. Wet pipe automatic sprinkler system throughout the Laboratory Remodel.
  2. Demolish existing pendent sprinklers and arm overs back to branch line. Install new piping and sprinklers in accordance with new ceiling layout.
  3. Fire watch, paid for by the Contractor, for any area under construction, and for any down time in phases not under construction.
  4. Coordinate all work with other trades. Install offsets to coordinate around other trades.
  5. Coordination and interface of alarm initiating and supervisory devices with the fire alarm system.
  6. Shop drawings.
  7. As-built drawings. The Contractor will be required to provide as-built drawings on disk/CD in AutoCAD format, in addition to required reproducible and blue-line drawings.
  8. On-site project supervision.
  9. Cabinet containing the required number and type of spare sprinklers and corresponding wrenches, to be located in the pump room.
  10. All required system testing in accordance with NFPA 13 and 25.
  11. Warranty on all materials and labor.
  12. All permits, taxes, and fees, including AHJ inspection and testing fees necessary to complete the specified work.

#### 1.04 RELATED WORK

- A. Materials and methods specified in other sections, included but not limited to:
  - 1. Cutting and patching.

#### 1.05 DESIGN CRITERIA

- A. Sprinkler System
  - 1. Laboratory, and Corridors: Wet system, with K-Factor of 5.6 sprinklers spaced to a maximum of 225 square feet per sprinkler. The system shall be designed to provide 0.10 gpm per square foot for the most remote 1,500 square foot area with a hose demand of 100 gpm (Light Hazard).

#### 1.06 APPLICABLE STANDARDS

- A. American National Standards Institute, Inc. (ANSI) Standards, current editions:
  - 1. A21.10a – Gray-Iron and Ductile-Iron Fittings, 2 inch through 48 inch for Water and Other Liquids.
  - 2. A21.11 – Rubber-Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.
  - 3. B16.1 – Cast-Iron Pipe Flanges and Flanged Fittings, 24, 125, 250, and 800 pounds.
  - 4. B16.3 – Malleable-Iron Threaded Fitting, Class 150 and 300.
  - 5. B16.4 – Cast-Iron Threaded Fitting, Class 125 and 250.
  - 6. B18.2.1 – Square and Hex Bolts and Screws.
  - 7. B18.2.2 – Square and Hex Nuts.
  - 8. B36.10 – Welded and Seamless Wrought Steel Pipe.
  - 9. B112.1 – Hose Valves for Fire Protection Services.
- A. American Society for Testing and Materials (ASTM) Standards, current edition:
  - 1. A 53 – Specifications for Welded and Seamless Steel Pipe.
  - 2. A 307 – Carbon Steel Externally and Internally Threaded Standard Fasteners.
- B. American Standard Mechanical Engineers (ASME) Standards, current edition:
  - 1. B1.20.1 – Pipe Threads, General Purpose.
- C. American Welding Society (AWS) Standards, current edition:
  - 1. D10.9 – Qualification of Welding Procedures and Welders for Piping and Tubing, Level AR-3.
  - 2. B2.1 – Specifications for Qualification of Welding Procedures and Welder for Piping and Tubing.
- D. California Building Code (CBC), 2016.
- E. California Electrical Code (CEC), 2016.
- F. California Fire Code (CFC), 2016.
- G. National Fire Protection Association 13 (NFPA 13) – Standard for the Installation of Sprinkler Systems, 2016 Edition.
- H. National Fire Protection Association 24 (NFPA 24) – Standard for the Installation of Private Fire Service Mains, 2016 Edition.
- I. National Fire Protection Association 25 (NFPA 25) – Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems, 2014 Edition as amended by the State of California.



J. Underwriters Laboratories, Inc. (UL) Publication:

1. Fire Protection Equipment List (Annually with Quarterly Supplements).

1.07 APPROVALS

- A. Obtain approval of shop drawings from Engineer and all applicable local, state, and federal authorities prior to fabrication and installation of materials.

1.08 SUBMITTALS

A. Shop Drawings

1. Submit three sets of complete shop drawings and three sets of manufacturer's data to Architect and Engineer for all necessary reviews prior to fabrication of materials.
2. Contractor shall submit complete system packages. Partial system submittals will be rejected.
3. Prepare shop drawings with a minimum scale of 3/16 inch = 1 foot-0 inch for plans, and 1/4 inch = 1 foot-0 inch for details. Show all piping, sprinklers, hangers, type of pipe, tube connections, outlets, type of roof construction, and occupancy of each area, including ceiling and roof heights as required by NFPA 13. When welding is planned, shop drawings shall indicate the sections to be shop welded and the type of welded fittings to be used. All drawings shall be prepared using AutoCAD.
4. Design shall be based on these specifications and the appropriate NFPA standards.

B. Changes

1. Make no changes in installation from layout as shown on the drawings unless change is specifically approved by the Engineer and AHJ. This does not include minor revisions for the purpose of coordination. Install offsets as required for coordination.
2. Any pipe fabricated and/or installed before all approvals are obtained at the Contractor's own expense and responsibility. Any changes made to the approved drawings other than as stated above are at the Contractor's own expense and responsibility.

C. Manufacturer's Data

1. Provide data from manufacturer on the following devices, including installation, maintenance, and testing procedures, dimensions, wiring diagrams, etc. Where any devices that are provided or furnished involve work by someone other than the Contractor, submit additional data copies directly to the Contractor. At a minimum, the following data sheets shall be provided:
  - a. Sprinklers and escutcheons.
  - b. Pipe, fittings, and hangers.
  - c. Fire stopping materials (including installation detail).
  - d. Seismic joint assembly.

D. As-Built Drawings

1. Maintain at the site an up-to-date marked set of as-built drawings, which shall be corrected and delivered to the Owner upon completion of work.
2. Upon completion, furnish the Owner with 3 sets of reproducible sepia prints, and one set in electronic AutoCAD "DWG" format of each reviewed shop drawing, revised to show "as-built" conditions.

E. Samples

1. Provide one sample of each type of sprinkler and escutcheon.

#### F. Final Inspection and Test

1. The Contractor shall make arrangements with the Owner, Architect, and Engineer for final inspection and witnessing of the final acceptance tests. The Owner, Architect, and the Engineer will witness the final inspection.
2. Perform all tests and inspections required by the referenced codes and standards, the AHJ, and the Owner.
3. When the Engineer visits the job site for final inspection and tests after being advised by the Contractor that the work is complete and ready for test, if the work has not been completed or the final acceptance tests are unsatisfactory, the Contractor shall be responsible for the Engineer's extra time and expenses for reinspection and witnessing the retesting of the work. Such extra fees shall be deducted from payments by the Owner to the Contractor.
4. Upon completion of final inspections and tests, as required by appropriate NFPA Standards, submit copies of Standard Contractor's Material and Test Certificate.

#### G. Operating Instructions

2. Furnish one copy of NFPA 25 and bound set of printed operating and maintenance instructions to the Owner, and adequately instruct the Owner's maintenance personnel in proper operation and test procedures of all fire protection components provided, furnished, or installed.

### 1.09 SPARE PARTS

- A. Provide and install one spare sprinkler cabinet, complete with 6 sprinklers of all types and temperature ratings used throughout the installation. The cabinet shall be equipped with sprinklers and special sprinkler wrenches required for each type of sprinkler installed.
- B. Confer with the Owner's representative for exact location of cabinet.

### 1.10 GUARANTEE

- A. The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by his (or his subcontractors') work, materials, or equipment.

### 1.11 PRODUCT DELIVERY

- A. Delivery of Materials
  1. Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.
- B. Storage of Materials, Equipment, and Fixtures
  1. Contractor shall be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.
- C. Handling Materials and Equipment
  1. Contractor shall be responsible for on-site handling of materials and equipment.

### 1.12 QUALITY ASSURANCE

- A. Testing Agency
  1. All materials shall be UL listed or FM approved for their intended use.

B. Regulatory Agencies

1. State and local building codes and ordinances, and fire department requirements shall apply.
2. The Contractor shall be fully experienced and licensed in all aspects of the fire protections systems herein specified.
3. Similar materials shall be from a single manufacturer.

1.13 JOB CONDITIONS

A. Damage

1. Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.

B. Leak Damage

1. The Contractor shall be responsible during the installation and testing periods of the sprinkler system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and shall pay for the necessary replacements or repairs to work of others damaged by such leakage.

1.14 EMERGENCY SERVICE

- A. The Contractor shall provide emergency repair service for the sprinkler system within four hours of a request for such service by the Owner during the warranty period. This service shall be available on a 24-hour per day, seven-day per week basis.

1.15 PERMITS AND FEES

- A. Pay for all permits, fees, and charges required for this work.

**PART 2 PRODUCTS**

2.01. GENERAL

- A. All components shall be used in accordance with the manufacturer's recommendations and its UL listing and/or FM approval.
- B. The naming of manufacturers in the specifications shall not be construed as eliminating the materials, products or services of other manufacturers and suppliers providing approved equivalent items.
- C. The substitutions of materials or products other than those named in the specifications are subject to proper approval of the Owner granted in writing.

2.02 ABOVEGROUND PIPE

A. Feed Mains and Branchline Piping

1. Pipe shall be new, rated for 175-psi working pressure, conforming to ASTM specifications, and have the manufacturer's name and brand along with the applicable ASTM standard marked on each length of pipe.
  - a. Pipe used shall be black steel and must comply with the specifications of the ASTM A 53 for welded and seamless steel pipe.

- b. Schedule 40 piping is required for sizes 2 inches and less. Pipe ends shall be threaded or roll grooved in accordance with NFPA 13.
- c. Schedule 10 pipe is acceptable in sizes 2½ inches and larger. Pipe ends shall be welded or roll grooved in accordance with NFPA 13.

### 2.03 FITTINGS AND JOINTS

#### A. Steel Pipe

- 1. Screwed fittings shall be cast iron, 175-pound class, black, and in accordance with ANSI B 16.4 or malleable iron, 175-pound class, black and in accordance with ANSI B 16.3. Bushings shall not be used.
- 2. Weld fittings shall be steel, standard weights, black, and in accordance with ASME B 16.9, ASME B 16.25, ASME B 16.5, ASME B 16.11 and ASTM A 234.
- 3. Grooved fittings and couplings shall be produced by the same manufacturer.
- 4. Grooved couplings shall be dimensionally compatible with pipe.

### 2.04 SPRINKLERS

- A. Sprinklers in light hazard and ordinary hazard occupancies shall be upright or pendent, quick-response type, nominal K-factor of 5.6, and ordinary temperature rating.
- B. Sprinklers in unfinished areas shall be rough brass finish. Sprinklers in finished areas shall have white paint finish.
- C. Pendent sprinklers installed in areas where ceilings are located shall be concealed and center or quarter point of tile.

### 2.05 SLEEVES FOR WALL/FLOOR PENETRATIONS

- A. Sleeves through walls and floors shall be of a type that can be made watertight and fire stopped.
  - 1. Sleeve sizes shall be as required by NFPA 13 for Earthquake Protection.

### 2.06 HANGERS

- A. All hanger components shall be of an approved and listed type.

## **PART 3 EXECUTION**

### 3.01 GENERAL

#### A. Product Delivery

- 1. Delivery of Materials
  - a. Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.
- 2. Storage of Materials, Equipment, and Fixtures
  - a. Contractor shall be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.
- 3. Handling Materials and Equipment
  - a. Contractor shall be responsible for on-site handling of materials and equipment.

B. Clean-up

1. Maintain the premises free from accumulation of waste materials or rubbish caused by this work.
2. At the completion of the work, removed all surplus materials, tools, etc., and leave the premises clean.

C. Leak Protection

1. Damage
  - a. Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.
2. Leak Damage
  - a. The Contractor shall be responsible during the installation and testing periods of the fire protection system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and shall pay for the necessary replacements or repairs to work of others damaged by such leakage.

D. Safety

1. All work shall be performed in compliance with the Occupational Safety and Health Act of 1970 and the Construction Safety Act Standards.
2. Contractor shall attend all job safety meetings.

1.2 FABRICATION

A. Pipe Ends

1. Ream and remove burrs after cutting pipe. Standard wall pipe ends shall be welded, threaded, cut grooved or plain end.
2. Thin wall pipe ends shall be plain end, welded or roll grooved in accordance with the fitting manufactures' recommendation.
3. Threads shall be in accordance with ASME B1.20.1.

B. Grooved Ends

1. Pipe minimum thickness, squareness and out-of roundness shall be in accordance with the coupling manufacturers specifications.
2. Pipe surface shall be free of indentations, projections, or roll marks from the end of the pipe to the groove.

C. Welding

1. No field welding of sprinkler piping shall be permitted.

2. Headers risers, feed mains, cross mains and branch lines may be shop welded using acceptable welding fittings. Welding methods shall comply with all the requirements of AWS B2.1.
3. Certified records shall be maintained upon the completion of each weld, welder shall stamp an imprint of their identification into the side of the pipe adjacent to the weld.

### 1.3 INSTALLATION

#### A. General

1. A clean set of prints or shop drawings shall be maintained at the site and marked up to show any changes.
2. Piping shall be installed above ceilings except in areas where there is no ceiling. Install piping in exposed areas as high as possible using necessary fittings and auxiliary drains to maintain maximum clear head room.

### 1.4 HANGERS, SUPPORTS, AND EARTHQUAKE BRACING

#### A. General

1. All piping must be substantially supported from building structure and only approved types of hangers shall be used. Piping lines under ducts shall not be supported from ductwork, but shall be supported from building structure with trapeze hangers where necessary or from steel angles supporting ductwork in accordance with NFPA 13.
2. All thread rods shall not be bent.
3. Hanger components shall be ferrous.

### 1.5 SYSTEM ACCEPTANCE

#### A. Tests

1. General system test shall be coordinated with the owner's representatives for training and witnessed by the AHJ. Problems noted during testing such as air or water leaks, difficulty in operating valves, alarm failures, etc. shall be corrected before the Contractor leaves the job.
2. Hydrostatically test all piping, including fire department connections between the check valve and connection, at 200 psi for two hours. If the highest static pressure at the lowest point in the system exceeds 150 psi, the system shall be tested at 50 psi more than the highest static pressure.

- B. Contractor's material and test certificates shall be completed for each system/floor and signed by the Contractor and witnessed by the owner's representative/AHJ.

END OF SECTION

## SECTION 22 05 00

### PLUMBING GENERAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. The General Conditions and Supplementary Conditions shall apply to and form part of this Division.

##### 1.2 SUMMARY

- A. Work includes, but is not limited to, the following:
  - 1. Labor, material, equipment, and transportation to complete the Work as shown on the drawings, specified herein and/or implied thereby.
  - 2. A requirement of the plumbing sections shall be to provide make-up water and drain connections to systems and equipment.
  - 3. Work specified in other Division 22 Sections.
  - 4. Coordination with work specified in Division 2; Division 21; Division 23; Division 26; and Division 31.
  - 5. Coordination and support for work specified under Division 01 and Division 23, Section Commissioning.
  - 6. Plumbing and other work related to Division 22 as specified under the following Division 23 Sections:
    - a. 230529, Hangers and Supports.
    - b. 230548, Mechanical Vibration and Seismic Controls.
    - c. 230553, Mechanical Identification.
    - d. 230593, Testing, Adjusting, and Balancing.
    - e. 230719, Pipe Insulation.
  - 7. It is the intent of the project that the installation be coordinated to provide a complete and usable facility.
- B. Work not included in this division:
  - 1. Painting, except as hereinafter specified. See Division 9 for painting.
  - 2. Electrical, except for controls hereinafter specified. See Division 26 for Electrical.

##### 1.3 DEFINITIONS

- A. Unless otherwise specified, "all clarification from," "field direction by," "submittals to," "approved by," "processed by," "permission from," and like mentioned herein shall mean from/by/to Architect.
- B. "Provide" means furnish and install referenced item with all appurtenances.
- C. "Shall" indicates a mandatory requirement.



- D. "Air conditioning" is defined as the treatment and/or handling of any air to any degree by the systems shown on the drawings and herein specified and is not restricted to refrigerated cooling.

#### 1.4 DELIVERY AND STORAGE OF MATERIALS

- A. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage from any cause whatever, and provide adequate and proper storage facilities during the progress of the work. Replace all damaged and defective work, material, or equipment prior to filing application for final acceptance. Properly protect all openings to equipment, piping, ductwork, accessories, etc. from dirt, dust, and debris prior to and during installation of the work. Ductwork and piping stored at the jobsite shall be covered and capped to protect from dirt, dust, debris, fire proofing, etc.

#### 1.5 CODES AND STANDARDS

- A. Work and materials shall be in full accordance with the latest rules and regulations of the Office of Statewide Health Planning and Development (OSHPD), the State Fire Marshal; the California Electric Code (NEC); the California Plumbing Code; the California Plumbing Code; California Administrative Code, Title 24, (CAL/OSHA); Local Building Codes; Vol. II of the Uniform Building Code; Volume I and II of the California Building Code; SMACNA "Guidelines for Seismic Restraints of Plumbing Systems"; and other applicable codes, laws or regulations of bodies lawfully empowered and having jurisdiction over this project. Nothing in the plans or specifications shall be construed to permit work not conforming to these codes. When codes conflict with one another, comply with the larger, higher, or more restrictive standards without additional costs.

#### 1.6 PERMITS

- A. Obtain all permits, patent rights, and licenses that are required for the performing of this work by all laws, ordinances, rules and regulations, or orders of any officer and/or body having jurisdiction. Provide all notices necessary in connection therewith, and pay all fees relating thereto and all costs and expenses incurred on account thereof. No work shall be covered before inspection by the jurisdictional authorities and observation by the Architect or the owner's designated representatives.

#### 1.7 EXPLANATION AND PRECEDENCE OF DRAWINGS

- A. Drawings and specifications are intended to be read together so that any work mentioned in one and not the other shall be executed the same as if mentioned in both.
- B. For purposes of clearness and legibility, drawings are essentially diagrammatic. Approximate only. The contractor shall review the drawings, including architectural, civil, structural, mechanical, plumbing, fire protection, electrical, and other related elements of the construction documents, to identify specific requirements for off-sets, transitions, anchorages, and attachments necessary to provide the mechanical systems as diagrammatically indicated in the construction documents.

- C. The design drawings intended arrangements are intended to be diagrammatic and do not indicate required offsets, attachments and fittings necessary to route and install the exact ductwork and piping. Fabricate and install based upon actual field measurements. Do not use unstated dimensions from BIM design model for creation of fabrication drawings. Coordinate detailed routing with other trades and building structure and architecture and submit comprehensive shop drawings. Indicated locations and arrangements were used for basic pipe and ductwork sizing, expansion, pump sizing, and other design considerations. Install piping and ductwork generally as indicated on diagrammatic drawings and provide offsets and fittings to accommodate and coordinate with building structure and other trades. Identify all arrangements on comprehensive shop drawings and submit for review and approval. The size and location of equipment is drawn to scale wherever possible. Contractor shall make use of data in the contract documents and shall verify this information at the building site. Refer to field survey and shop drawing requirements
- D. Where the contract specifications and/or drawings are in conflict, obtain clarification of such during bidding. Where addenda for clarification of such is not timely, base the bid on the higher standards or more restrictive requirements; prior to fabrication, obtain written clarification.
- E. The drawings indicate required size and points of termination of pipes, and suggest proper routes to conform to structure, avoid obstructions, and preserve clearances. It is not intended that drawings indicate necessary offsets, transitions, fittings, supports, or other components required to accommodate the required routing. The Contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, conceal work, preserve headroom, and keep openings and passageways clear, without further instructions or costs to the Government.
- F. It is intended that apparatus be located symmetrical and aligned with architectural elements. Refer to architectural plans and details in completing the correlating work.
- G. The Contractor shall study all drawings and specifications including, and not limited to, architectural, civil, structural, mechanical, plumbing, fire protection, and electrical to determine conflict with ordinances and statutes. Conflicts, errors or omissions shall be reported in writing, and changes shall be included in the as-built drawings and the additional work performed at no additional cost to the Government.
- H. Submittal of bid shall indicate the Contractor has examined the site and drawings and has included required allowances in his bid. Contractor's Bid shall include all costs for the required mechanical work, coordination, drawings, and changes as outline above. No allowance or additional compensation shall be allowed after Bid for any error or work resulting from Contractor's failure to visit job site and to review drawings and specifications as require herein

- I. OSHPD CHANGE ORDER APPROVAL: Contractor shall perform a full field survey and provide fully coordinated shop drawings per sections below. Any proposed deviations from the OSHPD approved contract drawings due to unforeseen field conditions or contractor proposed changes shall not be performed until approved by the design professional of record and OSHPD through approved change order documents. Any proposed deviations from the contract drawings shall be fully identified in the contractor's shop drawings. Contractor shall allow 45 days in schedule from approval of deviations by the design professional of record to the approval by OSHPD of the deviations in a change order document/ACD. Contractor shall not proceed without an approved ACD. Any further changes found in the field due to unforeseen conditions during construction after the approval of the coordinated shop drawings shall require further OSHPD approved change orders. Contractor shall allow additional 45 days in schedule for each additional change order/ACD.

## 1.8 RECORD DRAWINGS

- A. In addition to requirements for shop drawings specified elsewhere, provide and maintain on the job one complete set of blue line prints of the record drawings for all the plumbing work. Carefully record on this set of prints, work including piping, valves, etc., which is installed differently from that indicated in the specifications and on the drawings; locate dimensionally from fixed points. The depth and location shall be indicated for all plugged wyes, tees and capped lines.
- B. These record drawings shall be continuously kept up-to-date and shall be available for inspection at all times. Existing lines discovered shall be indicated on these drawings.
- C. At completion of work, provide a neat and legible reproducible set of these up-to-date record drawings which shall be individually signed and dated by the Contractor and the job inspector stating that the documents are accurate and reflect the as-built condition of the construction.
- D. Record drawings shall be submitted for acceptance and approval to the Architect and Engineer before final certificate of acceptance will be issued.
- E. Record drawings shall show the exact location of all valves, balancing devices, access doors, and control sensors and devices.

## 1.9 CUTTING AND PATCHING

- A. Perform all cutting and fitting required for work of this division in rough construction of the building. Obtain permission of the Structural Engineer prior to cutting any structural building elements.
- B. All patching of finished construction of building shall be performed under the sections of specifications covering these materials by the trades at no additional cost to the Owner.
- C. All cutting of concrete work by Contractor shall be by core drilling or concrete saw. No cutting or coring shall be done without first obtaining the permission of the Architect and Owner.
- D. All patching of existing surfaces shall match existing material and finish.

#### 1.10 DAMAGE BY LEAKS

- A. Contractor shall be responsible for damage to the grounds, walks, roads, buildings, finishes, surfaces, materials, equipment, piping systems, electrical systems and their equipment and contents, caused by leaks in the piping systems being installed or having been installed herein. Contractor shall repair at his expense all damage so caused. All repair work shall be done as directed by the Architect and Owner.

#### 1.11 EMERGENCY REPAIRS

- A. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond or relieving the Contractor of his responsibilities.

#### 1.12 LOCATIONS

- A. Coordinate in advance of the work, requirements for openings, equipment maintenance clearances, offsets, supports, expansion and contraction, recesses, and chases in the walls, partitions, equipment housekeeping pads, framing or openings. Should furnishing this information be neglected, delayed, or incorrect and additional cutting is found to be required, the cost of same shall be borne by the Contractor. Nothing in this paragraph shall be construed to relieve the Contractor of the responsibility for providing and paying for the required core drilling and openings in existing work.
- B. Diagrammatic Indications on Drawings are:
  - 1. Approximate only. The contractor shall review the drawings, including architectural, civil, structural, plumbing, fire protection, electrical, and other related elements of the construction documents, to identify specific requirements for off-sets, transitions, anchorages, and attachments necessary to provide the plumbing systems as diagrammatically indicated in the construction documents.
  - 2. At various locations shown distorted for clarity.
- C. Exact Locations Shall:
  - 1. Be as required for proper installation in available space.
  - 2. Avoid interference with architectural, electrical, fire protection, structural and other construction features.
  - 3. Be coordinated with the work of other trades toward the general purpose of having the work progress rapidly and smoothly without interference between one trade and another.
  - 4. Preserve headroom and keep openings and passageways clear.
  - 5. Have a neat arrangement symmetrical to the building lines, light and tile patterns.
  - 6. Be reasonably accessible for suspended ceiling areas for maintenance from the floor below. Adequate access for all equipment, valves, and other items requiring maintenance, adjustment, and/or observation shall be provided.

#### 1.13 SUPPORTS, EQUIPMENT PADS, STAGING, ETC.

- A. Construction supports required for the proper installation of equipment shall be in accordance with the drawings, manufacturer's requirements, seismic requirements, and applicable codes. Check architectural and structural drawings for equipment pads by others. Provide staging, scaffolds, platforms, ladders, and similar facilities required to properly install the work.

#### 1.14 INTERRUPTION OF UTILITIES

- A. This project includes elements of work which will require disconnection and modification of existing systems, with resultant outages. These outages must be strictly limited and controlled. No outage affecting any portion of the existing facilities will be allowed without specified written authorization by the Owner, Architect, and Engineer. Coordinate all work with project phasing requirements to maintain access and operation of portions of the work outside the specific area of the Phase under construction.
- B. The Contractor shall schedule and coordinate all interruptions of utilities with the Architect and Owner within 30 days after award of contract. The Contractor shall submit to the Owner a schedule of proposed interruptions. At least 144 hours prior to the interruption, the contractor shall submit a request indicating the proposed date and duration of interruption, the work to be accomplished, the areas which will be affected and a proposed contingency plan to be followed in the event that normal service or facilities cannot be restored on schedule. Do not commence work until the time, date, and contingency have been approved in writing by the Architect and Owner.
- C. Provide all labor and materials necessary to restore services on a contingency basis should normal service or facilities not be restored on schedule.
- D. Preparatory work associated with each interruption shall be performed during normal work hours. The actual interruption required for tie-in shall be performed between 8 P.M. and 5 A.M or at another time as required to minimize the impact on the operational activities of the hospital. Maximum shutdown during this period of any system shall be 4 hours.

#### 1.15 SUBSTITUTIONS

- A. If substitutions of materials, controls, or equipment impact or require any changes in the architectural, structural, plumbing, electrical, other equipment, or other work from that specified and shown on the drawings, the extra cost of the equipment or architectural, structural, plumbing, electrical or other work shall be the responsibility of the Contractor requesting the substitution. All substitutions shall be approved by the Architect before purchase by the contractor.
- B. If the Contractor proposes substitutions of any equipment specified herein or on the drawings, it shall be the Contractor's responsibility to obtain approval from the Architect for such equipment as well as approval for anchorage of such equipment from the Architect, Structural Engineer, Mechanical Engineer, and governing approval agencies including the Office of Statewide Health Planning and Development (OSHPD) and the Department of State Architects (DSA). All costs required for such approval shall be the responsibility of the Contractor requesting the substitution.

#### 1.16 PREPARATION OF SUBMITTALS

- A. Refer to Division 1. In addition to the requirements of Division 1, comply with the additional requirements specified herein.

- B. Prior to commencement of work and in accordance with the General Requirements, submit for review six copies of proposed equipment and material submittals. The Contractor shall verify the delivery dates are compatible with the specified construction schedule; and verify the equipment is sized to accommodate the conditions specified, will fit within the available space, and allow for required clearances for service and maintenance. Submittals shall include manufacturer's names and model numbers, specific drawing and specification paragraph reference, and shall comply with specifications and drawings. Contractor's submittal shall be taken as evidence that the required review, coordination and verification has been completed.
- C. Provide formal submittal to the Architect. Review of the formal submittal is only for general conformance with design concept of project and general compliance with the information given in the contract documents. The Contractor is responsible for confirmation and correlation of the dimensions, quantities, and sizes for information that pertains to fabrication methods or construction techniques, and for coordination of work of all trades. Any deviations from the Drawings and Specifications shall be clearly and completely indicated (by a separate letter) in the formal submittals. Reviewed Submittals shall not relieve the Contractor of responsibility for errors or deviations or the requirement for compliance with the contract documents.
1. Where specific model numbers and/or manufacturers are specified or shown, it is the intent of the contract documents to procure the specified item(s). Alternate equipment may not be used unless data is submitted for consideration as a substitution in accordance with General Requirements and this section.
  2. Model numbers used may not indicate all features, options, or other specific components required for this specific installation. Modify the specified models to comply with the requirements, as specified or shown.
  3. Product Data for Proposed Substitutions:
    - a. Submit copies of complete data, with drawings and samples as appropriate, including:
      - 1) Comparison of the qualities of the proposed substitution with that specified.
      - 2) Changes required in other elements of the work because of the substitution.
      - 3) Affect on construction schedule.
      - 4) Cost data comparing the proposed substitution with the product specified.
      - 5) Availability of maintenance service and source of replacement materials.
      - 6) Reference to three projects similar to this where such equipment is installed and operating to two or more years. All references shall include the name and telephone number of personnel point of contact who is familiar with the operation of the referenced item.
    - b. Acceptance of substitutions is entirely at the discretion of the Architect and the Owner.
- D. Formal submittals shall be complete with catalog data and information properly marked to indicate equality of material (where substitution is allowed and desired) and adequacy in capacity and performance to meet minimum capacities or performance as specified or indicated. Arrange the submittals in the same sequence as these Specifications and indicate the Section and specific Paragraph number (in the upper right-hand side with tabs) for which each submittal page is intended. Incomplete submittals shall be rejected.

- E. Do not fabricate, order, or deliver materials or equipment until formal submittals have been approved. Where material or equipment is used without such permission, it is deemed that the material or equipment shall be in complete compliance with drawings and specifications. Where such materials or equipment are found to be not in compliance with the contract documents, the said items shall be removed and replaced with complying materials or equipment without additional cost.
- F. Submittals shall be bound and shall include, at a minimum, the following:
  - 1. Complete bill of materials listing materials and equipment furnished.
  - 2. Catalog cut sheets of each component being provided. Each item included in the submittal shall be highlighted or otherwise specifically identified. Any items that do not specifically apply to the submittal shall be crossed out.
  - 3. Provide completed black-line shop drawings of equipment detailing all field connection points.
  - 4. Dimensions, clearance requirements, weights, and capacities.
  - 5. Indication/certification of compliance with indicated or specified codes and standards.
  - 6. Wiring and control diagrams showing control interface as applicable.
  - 7. Warranty sheets.
  - 8. Pressure drops, velocities, temperatures, gages, and other requirements as applicable.
- G. All submittals shall be reviewed and approved by the Commissioning Authority prior to submittal to assure design intent is met and proper coordination is maintained.
- H. Contractor shall incur all costs for time spent by Engineer for review of more than two submittals on each item. Costs shall be based on Engineer's hourly billing rate schedule at the time of review. Rate schedule available upon request. Engineer shall invoice the contractor upon completion of review and shall be paid by the contractor within 30 days of date of invoice. Failure to remit payment will withdraw approval (if any) of the submittals in question.

#### 1.17 SHOP DRAWINGS

- A. Conditions indicated in the design drawings are based upon available as-built drawings and limited above ceiling surveys. Ductwork, piping and equipment shown represent estimated best possible location based on limited survey access available. Refer to division 01 for complete project BIM shop drawing requirements.
- B. Perform a full site survey within 15 days of contract award. Survey shall be all inclusive of all areas under scope of work and beyond for full systems installation. Notify the engineer of record and owner of any conditions that differ or have changed from the design drawings. The site survey shall be performed to determine detailed phasing plan and create fully coordinated comprehensive shop drawings.
- C. Comprehensive Shop Drawings: Proceed with the preparation of comprehensive 3-Dimensional shop drawings immediately upon receiving an authorization to proceed for the project. Shop drawings shall be originally prepared by the contractor. Provide minimum 1/4" scale shop drawings completed within a 3-dimensional model in Revit, AutoCAD, Navisworks or similar program. Submit a complete and comprehensive set of Shop Drawings in one package within 60 days of contract award and prior to material fabrication, order, and installation. Comprehensive Shop Drawings shall include but are not limited to:

1. Architectural, structural, electrical, plumbing, and other work specified under Divisions outside Division 23.
  2. Drawings showing full overlay and coordination with other trades included delegated seismic design drawings utilizing approved OSHPD OPM
  3. Duct and pipe (mechanical and plumbing) elevations.
  4. Double line ductwork and double line piping (mechanical and plumbing) for sizes 4" and larger. Piping smaller than 4" shall be single line.
  5. Actual size of purchased equipment.
  6. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work including.
  7. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
  8. Access panels including ceiling panels.
  9. Access clearances for equipment.
  10. Actual locations of diffusers, registers, and grilles.
  11. Actual locations of manual volume dampers including extractors and splitters.
  12. Locations of structural penetrations such as beams.
  13. Actual location of control panels and power connections to equipment.
  14. Color coded duct and piping based on material used.
  15. Label and tag schedule for equipment.
  16. Duct and piping off-sets and transitions to clear building architecture, structure, electrical, fire protection, or other tight or congested areas. Includes existing architecture, structure, electrical, fire protection,
  17. Existing building utilities being relocated to accommodate design.
  18. Room temperature sensor locations.
  19. Point of connection to utilities outside the building.
  20. Gridlines.
- D. Coordinate with other trades including delegated seismic shop drawings.
- E. Coordinate with existing conditions.
- F. Include signatures on the shop drawings from all applicable trades confirming all coordination has occurred and the submitted shop drawings are free from conflicts
- G. Submit a clash detection log from the software utilized indicated here are no clashes
- H. Submit a copy of shop drawings to General Contractor for distribution to other trades, including but not limited to the electrical, structural and fire sprinkler trades.
- I. All shop drawings shall be reviewed and approved by the Commissioning Authority prior to submittal to assure design intent is met and proper coordination is maintained.
- J. Prior to fabrication and upon receiving approval from commissioning authority, submit a complete set of shop drawings at one time to the mechanical engineer.



## 1.18 COMMISSIONING

- A. Comprehensive Commissioning is an integral part of the work required. Provide comprehensive Commissioning of Mechanical systems in accordance with Division 01 and 23 Section "Commissioning" and as specified elsewhere in these Specifications. The work required for all Division 22 and 23 Sections includes cooperation and assistance with the Commissioning Authority to provide a fully Commissioned system. Review the commissioning requirements of the project and provide required support, including but not limited to, systems operation and adjustment, material and equipment submittals and documentation, systems start-up and testing, attendance at regular Commissioning meetings, cooperation with the Commissioning Authority and other trades in addressing and solving questions, conflicts and other issues that occur during the construction process.

## 1.19 ELECTRICAL REQUIREMENTS

- A. Coordinate the following items with Division 26:
  - 1. Power wiring
  - 2. Power Supply Voltage Requirements
  - 3. Safety switches
  - 4. Combination controllers
  - 5. Disconnect switches
  - 6. Motor starters
  - 7. Circuit breakers
  - 8. Motor-control equipment forming part of motor control centers or switchgear assemblies
  - 9. Electrical connections of the plumbing equipment to the electrical power source shall be coordinated with and provided under Division 26.

## 1.20 MOTORS

- A. Before order is placed for electrical devices, the Contractor shall check with the Electrical contractor and verify requirements as to type, mounting, and current characteristics as well as to any special delivery instructions.

## 1.21 TESTS

- A. Contractor shall make tests required by legally constituted authorities, required under other Division 22 sections, and as listed below.
  - 1. Tests shall be made in the presence of the Owner or his representative, a duly authorized inspector, and the Commissioning Authority. The Owner or his representative shall be notified 5 days before tests are made.
  - 2. Concealed work and insulated work shall remain uncovered until required testing has been performed and approved by the Owner. If work to be tested is covered before the approval of the Owner or his authorized representative has been obtained, it shall be uncovered for testing at the Contractor's expense.
  - 3. Obtain required documents of certification indicating approval, acceptance, and compliance with the requirements of all administrative authorities having jurisdiction over the work. No final payment shall be made until all such certificates are delivered to the Owner.
  - 4. Furnish labor, materials, instruments, and bear other costs in connection with all tests.

5. Piping systems, except as hereinafter noted, shall be given hydrostatic (with water) test of a least 150% of the maximum operating pressure but no less than 150 psig.
6. Before making test, remove or valve off from the system, gauges, traps, and other apparatus or equipment which may be damaged by test pressure.
7. Install a calibrated test pressure gauge in the system to observe any loss in pressure. Maintain the required test pressure for a sufficient length of time to enable an inspection to be made of all joints and connections, but not less than 4-hour. Perform tests after installation and prior to acceptance.
8. Prepare and submit a valve line-up diagram and verify that the entire system is subject to test pressure. Indicate line-up and area to be tested on a system diagram and submit to the Engineer, the Owner, and the Commissioning Authority.
9. Final pressures at the end of the test period shall be no more or less than that caused by expansion or contraction of the test medium due to temperature changes.
10. After tests have been made and leaks repaired, clean and flush systems as hereinafter specified. Water piping shall be left under supply main pressure for the balance of the construction period.
11. Additional tests for plumbing and fire protection systems are specified within their own section. Equipment and ductwork system tests are specified in the test and balance section.
12. Provide necessary provisions and tests for maintaining the operational condition and cleanliness of existing systems as well as systems provided under this Contract.

#### 1.22 LABOR AND MATERIALS

- A. Labor shall be carefully skilled for this kind of work, and under the direction of a competent foreman.
- B. Materials shall be new, in perfect condition and of domestic manufacturer. Materials for similar uses shall be of the same type and manufacturer.
- C. Equipment shall bear the manufacturer's label showing performance characteristics as well as model numbers. Identifying size number shall be given only when it is not practicable or customary to show performance characteristics.
- D. Valves, pipe, fittings, etc., shall bear the manufacturer's name or trademark and model.
- E. Unless otherwise specified herein, equipment and fixtures shall be installed in accordance with the manufacturer's recommendations, including recommended service and removal clearances.

### 1.23 PROTECTION AND CLEAN-UP

- A. Protection: Provide for the safety and good condition of materials and equipment until final acceptance of the Architect and Owner. Protect materials and equipment from dirt, dust, debris, and damage from any cause whatever, and provide adequate and proper storage facilities during the progress of the work. Properly protect all openings to equipment, piping, ductwork, accessories, etc. from dirt, dust, and debris prior to, during, and after installation of the work. Ductwork and piping stored at the jobsite shall be covered and capped to protect from dirt, dust, debris, fire proofing, etc. Replace all damaged and defective material, equipment or work precedent to filing application for final acceptance.
- B. Cleaning:
  - 1. Unless a more stringent requirement is specified, thoroughly clean all parts of the piping, ductwork, fixtures, apparatus, and equipment. All parts shall be vacuumed thoroughly and cleaned of dirt, dust, debris, cement, plaster and other materials, and all grease and oil spots removed. Such surfaces shall be carefully wiped, and all cracks and corners scraped out and cleaned.
  - 2. Exposed rough metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left in clean condition to receive painter's finish. Where factory prime coat has been damaged, the work shall be repaired and restored under this section.

### 1.24 ACCESS PANELS

- A. Access Doors and Panels:
  - 1. Wherever volume dampers, fire dampers, smoke fire dampers, controls, valves or other items or parts of the installation which require periodic inspection or adjustments are concealed by permanent non-removable construction, an access door or panel shall be provided. Rating of access doors and panels shall be determined by the rating of the wall or ceiling in which panel is installed. Types to be as approved and as appropriate for the surface and construction in which it is installed. Verify all locations with Architect and other trades for access doors and related components requiring access prior to installation.
  - 2. Access doors and panels shall be of sufficient size and shall be located properly to assure access and service to the intended item.

### 1.25 MAINTENANCE, OPERATION INSTRUCTION

- A. General: Thoroughly instruct the Owner's operators in every detail of operation of the system. Provide the Owner with a list of all equipment, giving the manufacturer's name, model number, serial number, parts list and complete internal wiring diagrams. All directions for operation furnished by the manufacturer shall be carefully saved and turned over to the Owner, together with written sequence of operation, operating and maintenance instructions for each system and its equipment. Instruction shall consist of a minimum of two 8-hour periods over consecutive days and shall be 30% classroom and 70% at site location. Coordinate scheduling of instruction times and the number of attendees with Owner's operators. If required training is not enough for the operators to feel competent to operate/maintain equipment additional training may be provided to the owner and no additional cost. All MEP training shall be videotaped.

- B. Specific Data: Submit four complete sets of the following data to the Owner for approval prior to acceptance of the installation, complete and at one time; (partial or separate data will not be accepted) data shall consist of the following:
1. Valve Directory: Indicating valve number, location, function, and normal operating position for each valve. Include diagrams and plans indicating valve locations.
  2. Color code schedule for piping, ductwork, labeling, and other items or systems specified to be color coded.
  3. Equipment: List of name plates, including name plate data.
  4. Manufacturer's Literature: Copies of manufacturer's instructions for operation and maintenance of all plumbing equipment, including replacement parts lists and drawings. Mark or highlight brochure literature indicating the models, sizes, capacities, curve operating points, etc., in a manner to clearly indicate the equipment installed. Remove all pages or sheets from the bulletin and catalogs that do not pertain to equipment installed on the project.
  5. Written Instructions: Typewritten instructions for operation and maintenance of the system composed of OPERATING INSTRUCTIONS, MAINTENANCE INSTRUCTIONS, and a MAINTENANCE SCHEDULE.
    - a. OPERATING INSTRUCTIONS shall contain a brief description of the system. Adjustments requiring the technical knowledge of the service agency personnel shall not be included in the operating instructions. The fact such adjustments are required, however, shall be noted.
    - b. MAINTENANCE INSTRUCTIONS shall list each item of equipment requiring inspection, lubrication, or service and describe the performance of such maintenance.
    - c. MAINTENANCE SCHEDULE shall list each item of equipment requiring maintenance, shall show the exact type of maintenance on every component of each item of equipment, and shall show when each item of equipment should be inspected or services.
  6. Instructions: Operating personnel shall be instructed in the operation of the system in accordance with typewritten, approved instructions.
- C. Binders: Provide complete sets of the above data in loose-leaf ring-type binders with permanent covers, with identification on front and on spine.
- D. Extreme Event: Provide training on extreme event conditions. Refer to manufactures instructions, architectural specifications, and sequence of operations.

#### 1.26 SPECIAL REQUIREMENTS

- A. During the guarantee period and as directed by the Owner, make any additional tests, adjustment, etc., that may be required and correct any defects or deficiencies arising from operation of the systems. Operational tests shall be made during both heating and cooling seasons and on all systems.
- B. Completion:
1. The entire plumbing system shall be commissioned in accordance with ASHRAE Guideline 1-1996 and the requirements of this specification. The Commissioning process shall occur throughout the construction with periodic reports submitted

monthly or more frequently when required. A final commissioning report shall be submitted by the Contractor and approved by the Owner, Architect, and Mechanical Engineer prior to final acceptance of the work.

2. When the installation is complete and adjustments specified herein have been made, the system shall be operated for a period of one week, during which time it shall be demonstrated to the Owner or his representative as being completed and operating in conformance with these specifications. The Contractor shall schedule all work so that this time period, which is to confirm a "bug-free" system, will occur before the total project is accepted for substantial completion by Owner.
3. The work hereunder shall not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, valve directories, piping identification code directory, nameplates, and Commissioning specified herein have been approved and properly posted in the building.

#### 1.27 WARRANTY / GUARANTEE

- A. The contractor shall warranty/guarantee that materials, apparatus, and equipment furnished and installed under the plumbing division of these specifications shall be new and free from all defects. Should any defects develop, within two years (unless a longer period is listed in other sections of the specifications) from the date of final acceptance by the owner or from the date of certificate of substantial completion, whichever is earlier, due to inferior or faulty materials and/or workmanship, the trouble shall be corrected by this Contractor without expense to the Owner. Any defective materials or inferior workmanship noticed at the time of installation or during the guarantee period shall be corrected immediately to the entire satisfaction of the Owner.
- B. The work shall be installed of such materials and in such a manner that:
  1. The operation of all parts of the system shall be noiseless to the extent that no objectionable sound of operation will be heard outside of the rooms enclosing the apparatus or equipment.
  2. Apparatus or equipment shall operate in accordance with detailed specifications covering each item.
  3. Contractor shall, at his own expense, make any adjustments or changes required to produce a condition of quietness satisfactory to the Engineer or his representative. Such adjustments or changes shall not reduce the performance or quantities called for on the drawings.
  4. Contractor shall guarantee that his installation of all materials and equipment will meet the performance requirements of these specifications and that all equipment will deliver the specified or required capacities.
  5. The Owner reserves the right to make temporary or emergency repairs as necessary to keep equipment in operating condition without voiding the guarantee contained herein or relieving the Contractor of his responsibilities during the guarantee period.
  6. Contractor shall be responsible for all damage to any part of the premises caused by leaks or break in pipe lines, fixtures or equipment furnished and installed under his contract for a period of two years after date of acceptance of the project by Owner. He shall replace in kind, at his own expense, any and all items so damaged to the complete satisfaction of the Owner.

**END OF SECTION**

## SECTION 220517

### SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

#### 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. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Grout.
  - 5. Silicone sealants.

##### 1.3 ACTION SUBMITTALS

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

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### PART 2 - PRODUCTS

##### 2.1 SLEEVES

- A. Manufacturers
  - 1. Advance Products and Systems
  - 2. CALIPCO
  - 3. GPT
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

##### 2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers:
  - 1. Jay R. Smith Mfg. Co.
  - 2. Zurn Industries
- B. Description: Manufactured, galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

##### 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers:
  - 1. Advance Products & Systems

2. CALPICO
3. GPT
4. Metraflex Company
5. Proco Products

B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Stainless steel, Type 316.
5. Connecting Bolts and Nuts: Stainless steel, Type 316 of length required to secure pressure plates to sealing elements.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

**PART 3 - EXECUTION**

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  1. 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. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. 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.

### 3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Use **grout** to seal the space around outside of sleeve-seal fittings.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.



C. Prepare test and inspection reports.

### 3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
  - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
  - b. Piping NPS 6 and Larger: Steel pipe sleeves.
2. Exterior Concrete Walls below Grade:
  - a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
  - a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
  - a. Piping Smaller Than NPS 6: Steel pipe sleeves or Stack-sleeve fittings.
  - b. Piping NPS 6 and Larger: Steel pipe sleeves or Stack-sleeve fittings.
5. Interior Partitions:
  - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
  - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

**END OF SECTION**

**SECTION 220518**  
**ESCUTCHEONS FOR PLUMBING PIPING**

**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. Escutcheons.
  - 2. Floor plates.

1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

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

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. BrassCraft Manufacturing
- B. Dearborn Brass
- C. Jones Stephens Corp.
- D. Keeney Manufacturing Company
- E. Mid-America Fittings
- F. ProFlo

2.2 ESCUTCHEONS

- A. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- B. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped **brass** with polished, chrome-plated finish and spring-clip fasteners.
- D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

**PART 3 - EXECUTION**

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
    - d. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
    - f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
    - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
    - h. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
    - i. Bare Piping in Unfinished Service Spaces: One-piece cast brass with rough-brass finish.
    - j. Bare Piping in Equipment Rooms: One-piece cast brass with rough-brass finish.
  2. Escutcheons for Existing Piping to Remain:
    - a. Chrome-Plated Piping: Split-casting, stamped steel with concealed hinge with polished, chrome-plated finish.
    - b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
    - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
    - f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
  - C. Install floor plates for piping penetrations of equipment-room floors.
  - D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
    1. New Piping: One-piece, floor plate.
    2. Existing Piping: Split floor plate.
- 3.2 FIELD QUALITY CONTROL
- A. Using new materials, replace broken and damaged escutcheons and floor plates.

**END OF SECTION**

## SECTION 220523.12

### BALL VALVES FOR PLUMBING PIPING

#### 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. Brass ball valves.
  - 2. Bronze ball valves.

##### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 and NSF 372.

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

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, and soldered ends.
  - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.1 for flanges on iron valves.
  - 3. ASME B16.5 for flanges on steel valves.
  - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 5. ASME B16.18 for solder-joint connections.
  - 6. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
  - 1. Handlever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
  - 1. Include 2-inch stem extensions.
  - 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
  - 3. Memory stops that are fully adjustable after insulation is applied.

## 2.2 BRASS BALL VALVES

- A. Brass Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:
  - 1. Manufacturer:
    - a. Marwin Valve
  - 2. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Three piece.
    - d. Body Material: Forged brass.
    - e. Ends: Threaded and soldered.
    - f. Seats: PTFE.
    - g. Stem: Stainless steel.
    - h. Ball: Stainless steel, vented.
    - i. Port: Full.

## 2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:
  - 1. Manufacturer:
    - a. Apollo Flow Controls
    - b. Hammond Valve
    - c. Malwaukee Valve Company
    - d. NIBCO
    - e. WATTS
  - 2. Description:
    - a. Standard: MSS SP-110.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Three piece.

- d. Body Material: Bronze.
- e. Ends: Threaded.
- f. Seats: PTFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Full.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

#### **3.2 VALVE INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

#### **3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 3 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

#### **3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE**

- A. Pipe NPS 3 and Smaller:
  - 1. Brass ball valves, three-piece with full port and stainless steel trim.
  - 2. Bronze ball valves, three-piece with full port and stainless steel trim.

**END OF SECTION**



**SECTION 220523.14**  
**CHECK VALVES FOR PLUMBING PIPING**

**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. Bronze swing check valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, and weld ends.
  - 3. Set check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

**PART 2 - PRODUCTS**

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.1 for flanges on iron valves.
  - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 4. ASME B16.18 for solder joint.
  - 5. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.



- D. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.
- E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 125:
  - 1. Manufacturer:
    - a. American Valve
    - b. Apollo Flow Controls
    - c. Crane
    - d. Hammond Valve
    - e. Jenkins Valves
    - f. Milwaukee Valve Company
    - g. NIBCO
    - h. Powell Valves
    - i. Red-White Valve Corp
    - j. Watts
  - 2. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B62, bronze.
    - e. Ends: Threaded or soldered. See valve schedule articles.
    - f. Disc: Bronze.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

- E. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Check Valves: Install check valves for proper direction of flow.
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
- F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. End Connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.

### 3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze swing check valves with bronze disc, Class 125, with soldered or threaded end connections.

**END OF SECTION**



## SECTION 220529

### HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

#### 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 pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe-positioning systems.
8. Equipment supports.

###### B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

##### 1.3 ACTION SUBMITTALS

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

###### B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

###### C. Delegated-Design Submittal: Trapeze hangers 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. Detail fabrication and assembly of hangers.
2. Include design calculations for designing hangers.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

### **PART 2 - PRODUCTS**

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers, wall supports, floor supports, and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

#### 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pre-galvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe and Tube Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

## 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel or stainless-steel, Type 316 channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
7. Metallic Coating: Pre-galvanized G90.
8. Paint Coating: Green epoxy, acrylic, or urethane.
9. Plastic Coating: PVC.

## 2.5 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturer:

1. Buckaroos
2. Carpenter & Paterson
3. Nation Pipe Hangar Corporation
4. nVent
5. Pipe Shields
6. Piping Technology & Products
7. Rilco Manufacturing Company
8. Value Engineered Products

- B. Insulation-Insert Material for Cold Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Manufacturer:
    - a. Hilti, Inc
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Manufacturer:
    - a. Eaton (B-line)
    - b. Hilti, Inc
  - 2. Indoor Applications (Except Mechanical Rooms and Wet Areas): Zinc-coated steel.
  - 3. Mechanical Rooms and Wet Areas: Stainless Steel.
  - 4. Outdoor Applications: Stainless steel.

## 2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
  - 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  - 3. Hardware: Galvanized steel or polycarbonate.
  - 4. Accessories: Protection pads.
- C. Low-Profile, Single-Base, Single-Pipe Stand:
  - 1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
  - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  - 3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
  - 4. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.
  - 5. Pipe Supports: Roller, Strut clamps, Clevis hanger, or Swivel hanger.
  - 6. Hardware: Galvanized-steel.
  - 7. Accessories: Protection pads.
  - 8. Height: 12 inches above roof.
- D. 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.

## 2.8 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

## 2.10 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011.
- C. Structural Steel: ASTM A36 carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240.
- E. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Non-staining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## **PART 3 - EXECUTION**

### 3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. 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.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A36 carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured only when specifically permitted by the project Structural Engineer. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:



1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and within three pipe diameters of changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- O. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

- d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- 5. Pipes NPS 8 and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1 inch.

### 3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those 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 a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

- a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use mechanical-expansion anchors instead of building attachments in concrete construction. Powder – actuated fasteners are only permitted when specifically identified by the project Structural Engineer.
- S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

**END OF SECTION**



## SECTION 220553

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

#### 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. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Stencils.
  - 5. Valve tags.
  - 6. Warning tags.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

#### PART 2 - PRODUCTS

##### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Manufacturers
    - a. Brady Corporation
    - b. Brimar Industries
    - c. Carlton Industries
    - d. Champion America
    - e. Craftmark Pipe Markers
    - f. Emedco
    - g. Kolbi Pipe Marker
    - h. LEM Products
    - i. Marking Services
    - j. Seton Identification Products



2. Material and Thickness: Brass, 0.032-inch or stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  3. Letter Color: White.
  4. Background Color: Black.
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  7. Fasteners: Stainless-steel rivets or self-tapping screws.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate 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.

## 2.2 WARNING SIGNS AND LABELS

- A. Manufacturerers
1. Brady Corporation
  2. Brimar Industries
  3. Champion America
  4. Craftmark Pipe Markers
  5. Emedco
  6. LEM Products
  7. Marking Services Inc.
  8. National Marker Company
  9. Seton Identification Products
  10. Stranco, Inc.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Black.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater

viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 PIPE LABELS

### A. Manufacturers

1. Actioncraft Products
2. Brady Corporation
3. Brimar Industries
4. Carlton Industries
5. Champion America
6. Craftmark Pipe Markers
7. Emedco
8. Kolbi Pipe Marker
9. LEM Products
10. Marking Services
11. Seton Identification Products

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to **cover full** circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

## 2.4 VALVE TAGS

### A. Manufacturers

1. Actioncraft Products
2. Brady Corporation
3. Brimar Industries
4. Carlton Industries
5. Champion America
6. Craftmark Pipe Markers
7. Emedco

8. Kolbi Pipe Marker
  9. LEM Products
  10. Marking Services
  11. Seton Identification Products
- B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.032-inch or stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire-link chain or beaded chain.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.
- 2.5 WARNING TAGS
- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches.
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  4. Color: Safety yellow background with black lettering.

### **PART 3 - EXECUTION**

#### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

#### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

#### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

#### 3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 25 feet along each run.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
1. Domestic Water Piping
    - a. Background: Safety green.
    - b. Letter Colors: White.
  2. Domestic Hot Water
    - a. Background: Yellow
    - b. Letter Colors; Black
  3. Domestic Hot Water Return
    - a. Background: Yellow
    - b. Letter Colors; Black
  4. Sanitary Waste and Storm Drainage Piping:
    - a. Background Color: Match Existing Facility Color
    - b. Letter Color: Match Existing Facility Color

### 3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
    - a. Cold Water: 1-1/2 inches round.
    - b. Hot Water: 1-1/2 inches round.
  2. Valve-Tag Colors:
    - a. Cold Water: Natural.
    - b. Hot Water: Natural.
  3. Letter Colors:
    - a. Cold Water: White.
    - b. Hot Water: White.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION**

**SECTION 220719**  
**PLUMBING PIPING INSULATION**

**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 insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic recirculating hot-water piping.
  - 4. Roof drains and rainwater leaders.
  - 5. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at pipe expansion joints for each type of insulation.
  - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 5. Detail application of field-applied jackets.
  - 6. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.
- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- 1.7 COORDINATION
- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- 1.8 SCHEDULING
- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## **PART 2 - PRODUCTS**

### **2.1 INSULATION MATERIALS**

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
1. Manufacturer
    - a. Pittsburgh Corning Corporation
  2. Preformed Pipe Insulation: Type II, Class 2, with factory-applied ASJ-SSL jacket.
  3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- G. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
  - 1. Manufacturer
    - a. Johns Manville
    - b. Knauf Insulation
    - c. Manson Insulation
    - d. Owens Corning
  - 2. Preformed Pipe Insulation: Type I, Grade A, with factory-applied ASJ-SSL.
  - 3. 850 deg F.
  - 4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
  - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C534/C534M or ASTM C1427, Type I, Grade 1, for tubular materials.
  - 1. Manufacturer
    - a. Armacell LLC

## 2.2 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
  - 1. Manufacturer
    - a. Foster Brand
- C. Polyolefin Adhesive: Solvent-based adhesive.
  - 1. Manufacturer
    - a. Aeroflex
    - b. Armacell LLC
    - c. Foster Brand
    - d. K-flex
  - 2. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
  - 3. Wet Flash Point: Below 0 deg F.
  - 4. Service Temperature Range: 40 to 200 deg F.
  - 5. Color: Black.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Manufacturer
    - a. Childers Brand
    - b. Foster Brand
- E. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.



1. Manufacturer
  - a. Childers Brand
  - b. Foster Brand
  - c. Mon-Eco Industries

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturer
  - a. Dow Consumer Solutions
  - b. John Manville
  - c. PIC Plastics
  - d. Speedline Corporation

2.3 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. Manufacturer
  - a. Childers Brand
  - b. Foster Brand
  - c. Knauf Insulation
  - d. Vimasco Corporation
2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
5. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.

1. Manufacturer
  - a. Childers Brand
  - b. Foster Brand
2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturer
  - a. Childers Brand
  - b. Foster Brand
  - c. Knauf Insulation
  - d. Mon-Eco Industries
  - e. Vima

2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

#### 2.4 LAGGING ADHESIVES

- A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
  1. Manufacturer
    - a. Childers Brand
    - b. Foster Brand
    - c. Vimasco Corporation
  2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  3. Service Temperature Range: 20 to plus 180 deg F.
  4. Color: White.

#### 2.5 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
  1. Manufacturer
    - a. Childers Brand
    - b. Foster Brand
    - c. Mon-Eco Industries
    - d. Pittsburgh Corning Corporation
  2. Permanently flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 100 to plus 300 deg F.
  4. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
  1. Manufacturer
    - a. Childers Brand
    - b. Foster Brand
    - c. Mon-Eco Industries
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.
- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
  1. Manufacturer
    - a. Childers Brand

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

## 2.6 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

## 2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, 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. Manufacturer
    - a. Johns Mansville
    - b. PLC Plastics
    - c. Proto Corporation
    - d. Speedline Corporation
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:
  1. Manufacturer
    - a. ITW Insulation Systems
    - b. RPR Products
  2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.

- 3) Tee covers.
  - 4) Flange and union covers.
  - 5) End caps.
  - 6) Beveled collars.
  - 7) Valve covers.
  - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A240/A240M.
- a. Factory cut and rolled to size.
  - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Manufacturer
    - a. 3M Industrial Adhesives
    - b. Avery Dennison Corporation
    - c. Ideal Tape
    - d. Knauf Insulation
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Manufacturer
    - a. 3M Industrial Adhesives
    - b. Ideal Tape Co
  - 2. Width: 2 inches.
  - 3. Thickness: 6 mils.
  - 4. Adhesion: 64 ounces force/inch in width.
  - 5. Elongation: 500 percent.
  - 6. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Manufacturer
    - a. 3M Industrial Adhesives
    - b. Avery Dennison Corporation
    - c. Ideal Tape
    - d. Knauf Insulation
  - 2. Width: 2 inches.
  - 3. Thickness: 3.7 mils.
  - 4. Adhesion: 100 ounces force/inch in width.
  - 5. Elongation: 5 percent.
  - 6. Tensile Strength: 34 lbf/inch in width.

## 2.9 SECUREMENTS

- A. Bands:
  - 1. Manufacturers
    - a. ITW Insulation Systems
    - b. RPR Products
  - 2. Stainless Steel: ASTM A240/A240M, Type 316; 0.015-inch-thick, 1/2-inch-wide with wing seal.
  - 3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch-thick, 1/2-inch-wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.

## 2.10 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
  - 1. Manufacturer
    - a. Buckaroos
    - b. Just Manufacturing
    - c. McGuire Manufacturing

- d. MVG Molded Products
  - e. Plumberex Specialty Products
  - f. Tuebro
  - g. Zurn Industries
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
- 1. Manufacturer
    - a. Truebro
    - b. Zurn Industries
  - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

#### **3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

### 3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.



4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

#### A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
  - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.
  - 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.8 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
  - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
  - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  - 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
  - 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
  - 1. Install preformed pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
  - 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed sections of same material as that of straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.9 INSTALLATION OF POLYOLEFIN INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.10 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three

locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- F. All insulation applications will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

### 3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
    - c. Polyolefin: 1 inch thick.
  - 2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
    - c. Polyolefin: 1 inch thick.
- B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
  - 1. All Pipe Sizes: Insulation shall be:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- C. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Condensate Drains:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

### 3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:

1. None.
- D. Piping, Exposed:
1. Aluminum Stucco Embossed: 0.024 inch thick.
  2. Stainless Steel, Type 316, Smooth No. 2B Finish: 0.016 inch thick.

**END OF SECTION**



**SECTION 221116**  
**DOMESTIC WATER PIPING**

**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. Copper tube and fittings.
  - 2. Piping joining materials.
  - 3. Transition fittings.
  - 4. Dielectric fittings.

1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Pipe and tube.
  - 2. Fittings.
  - 3. Joining materials.
  - 4. Transition fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Owner no fewer than 14 days in advance of proposed interruption of water service.
  - 2. Do not interrupt water service without Owner's written permission.

**PART 2 - PRODUCTS**

2.1 PIPING MATERIALS

- A. Manufacturers
  - 1. Mueller Industries
  - 2. Cerro Flow Products
  - 3. Elkhart Products
  - 4. NIBCO
  - 5. JM Eagle
  - 6. Charlotte Pipe
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.



## 2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Annealed-Temper Copper Tube: ASTM B88, Type L.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- D. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- E. Wrought Copper Unions: ASME B16.22.

## 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
  - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

## 2.4 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.
  - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
  - 1. Manufacturer
    - a. Cascade Waterworks
    - b. Dresser
    - c. Ford Meter box Company
    - d. Jay R Smith Mfg
    - e. JCM Industries
    - f. Romac Industries
    - g. Smith-Blair
    - h. Viking Johnson

## 2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Standard: ASSE 1079.
  - 2. Pressure Rating: 125 psig minimum at 180 deg F.
  - 3. End Connections: Solder-joint copper alloy and threaded ferrous.

- C. Dielectric Flanges:
  1. Standard: ASSE 1079.
  2. Factory-fabricated, bolted, companion-flange assembly.
  3. Pressure Rating: 125 psig minimum at 180 deg F.
  4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
  1. Nonconducting materials for field assembly of companion flanges.
  2. Pressure Rating: 150 psig.
  3. Gasket: Neoprene or phenolic.
  4. Bolt Sleeves: Phenolic or polyethylene.
  5. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
  1. Standard: IAPMO PS 66.
  2. Electroplated steel nipple complying with ASTM F1545.
  3. Pressure Rating and Temperature: 300 psig at 225 deg F.
  4. End Connections: Male threaded or grooved.
  5. Lining: Inert and noncorrosive, propylene.

### **PART 3 - EXECUTION**

#### **3.1 PIPING APPLICATIONS**

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 3 and smaller, shall be the following: Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.

#### **3.2 INSTALLATION OF PIPING**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install valves according to the following:
  1. Section 220523.12 "Ball Valves for Plumbing Piping."
  2. Section 220523.14 "Check Valves for Plumbing Piping."
- D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- F. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

### 3.4 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

### 3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install hangers for copper tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of copper tubing and piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.8 ADJUSTING

- A. Perform the following adjustments before operation:
  1. Close drain valves, hydrants, and hose bibbs.
  2. Open shutoff valves to fully open position.
  3. Open throttling valves to proper setting.
  4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  7. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
    - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
  - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
  - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- 3.10 CLEANING
- A. Clean and disinfect potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Repeat procedures if biological examination shows contamination.
  - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

**END OF SECTION**



**SECTION 221119**  
**DOMESTIC WATER PIPING SPECIALTIES**

**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. Backflow preventers.
2. Balancing valves.
3. Water-hammer arresters.
4. Trap-seal primer device.
5. Trap-seal primer systems.
6. Flexible connectors.

B. Related Requirements:

1. Section 221116 "Domestic Water Piping" for water meters.
2. Section 224300 "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.

1.3 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  1. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS**

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National



Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

## 2.3 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers
  - a. Ames Fire & Waterworks
  - b. Apollo Flow Controls
  - c. FEBCO
  - d. WATTS
  - e. Zurn Industries
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss at Design Flow Rate: Per drawings.
5. Body: Bronze for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
  - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

## 2.4 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturer
  - a. Bell & Gossett
  - b. IMI Hydronic Engineer
  - c. Nexus Valve
  - d. NIBCO
  - e. Watts
2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

## 2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

### A. Individual-Fixture, Water Tempering Valves:

1. Manufacturer
  - a. Acorn Engineering Company
  - b. Lawler Manufacturing Company
  - c. Leonard Valve Company
  - d. Powers
  - e. Zurn Industries
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Connections: Threaded inlets and outlet.
7. Finish: Chrome plated.

## 2.6 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.7 TRAP-SEAL PRIMER DEVICE

### A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturer
  - a. Jay R Smith
  - b. Josam Company
  - c. MIFAB
  - d. Precision Plumbing Products
  - e. Sioux Chief Manufacturing
  - f. Watts
  - g. Zurn Industries
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

## 2.8 FLEXIBLE CONNECTORS

- A. Manufacturer
  - 1. Flex-Hose
  - 2. Mason Industries
  - 3. Metraflex Company
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
  - 1. Working-Pressure Rating: Minimum 250 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
  - 1. Working-Pressure Rating: Minimum 250 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
  - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- B. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- C. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- D. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

### 3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

### 3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

### 3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Backflow preventers.
2. Trap-seal primer device.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.6 ADJUSTING

- A. Set field-adjustable flow set points of balancing valves.
- B. Adjust each reduced-pressure-principle backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to 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.
  1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
  2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

**END OF SECTION**



## SECTION 221316

### SANITARY WASTE AND VENT PIPING

#### 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. Hubless, cast-iron soil pipe and fittings.
  - 2. Copper tube and fittings.
  - 3. Specialty pipe fittings.

##### 1.3 ACTION SUBMITTALS

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

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

##### 1.5 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Owner no fewer than 14 days in advance of proposed interruption of sanitary waste service.
  - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

##### 1.6 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

##### 2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturer
  - 1. AB & I Foundry
  - 2. Charlotte Pipe and Foundry Company
  - 3. Tyler Pipe
- B. Pipe and Fittings: ASTM A 888 or CISPI 301.
- C. CISPI, Hubless-Piping Couplings:
  - 1. Manufacturer
    - a. Charlotte Pipe and Foundry
    - b. JM Eagle
    - c. NIBCO
  - 2. Standards: ASTM C 1277 and CISPI 310.
  - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Manufacturer
    - a. Charlotte Pipe and Foundry
    - b. JM Eagle
    - c. NIBCO
  - 2. Standards: ASTM C 1277 and ASTM C 1540.
  - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- E. Cast-Iron, Hubless-Piping Couplings:
  - 1. Manufacturer
    - a. Charlotte Pipe and Foundry
    - b. MG Piping Products Company
  - 2. Standard: ASTM C 1277.
  - 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

### 2.4 STAINLESS-STEEL DRAINAGE PIPE AND FITTINGS

- A. Description: Comply with requirements of ASME A112.3.1, drainage pattern.
- B. Material: Type 316L stainless steel.
- C. Pipe Construction: Seamless.
- D. Internal Sealing Rings: EPDM or NBR.
- E. Joints: Single or double, socket and spigot ends.

## 2.5 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
- D. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- E. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- F. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 2. Shielded, Non-pressure Transition Couplings:
    - a. Standard: ASTM C 1460.
    - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. End Connections: Same size as and compatible with pipes to be joined.
  - 3. Pressure Transition Couplings:
    - a. Standard: AWWA C219.
    - b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
    - c. Center-Sleeve Material: Stainless steel.
    - d. Gasket Material: Natural or synthetic rubber.
    - e. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
  - 1. Dielectric Unions:
    - a. Description:
      - 1) Standard: ASSE 1079.
      - 2) Pressure Rating: 125 psig minimum at 180 deg F.
      - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
  - 2. Dielectric Flanges:



- a. Description:
  - 1) Standard: ASSE 1079.
  - 2) Factory-fabricated, bolted, companion-flange assembly.
  - 3) Pressure Rating: 125 psig minimum at 180 deg F.
  - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- 3. Dielectric-Flange Insulating Kits:
  - a. Description:
    - 1) Nonconducting materials for field assembly of companion flanges.
    - 2) Pressure Rating: 150 psig.
    - 3) Gasket: Neoprene or phenolic.
    - 4) Bolt Sleeves: Phenolic or polyethylene.
    - 5) Washers: Phenolic with steel backing washers.
- 4. Dielectric Nipples:
  - a. Description:
    - 1) Standard: IAPMO PS 66.
    - 2) Electroplated steel nipple.
    - 3) Pressure Rating: 300 psig at 225 deg F.
    - 4) End Connections: Male threaded.
    - 5) Lining: Inert and noncorrosive, propylene.

### **PART 3 - EXECUTION**

#### **3.1 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.

- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger unless noted otherwise.
  - 2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow unless noted otherwise.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Install steel piping according to applicable plumbing code.
- O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- P. Plumbing Specialties:
  - 1. Install backwater valves in sanitary waster gravity-flow piping.
    - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 3. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 3.2 JOINT CONSTRUCTION
- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
  - B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
  - C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
  - D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
    1. Cut threads full and clean using sharp dies.
    2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
      - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
      - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
      - c. Do not use pipe sections that have cracked or open welds.
  - E. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
  - F. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- 3.3 SPECIALTY PIPE FITTING INSTALLATION
- A. Transition Couplings:
    1. Install transition couplings at joints of piping with small differences in ODs.
    2. In Waste Drainage Piping: Shielded, non-pressure transition couplings.
  - B. Dielectric Fittings:
    1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
    2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
    3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
    4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.
- 3.4 INSTALLATION OF HANGERS AND SUPPORTS
- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install hangers for cast-iron stainless-steel and copper soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- E. Support vertical runs of cast iron and copper soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
  - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 6. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.6 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

### 3.8 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.9 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
  1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
  2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
  1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
  2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
    - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

**END OF SECTION**



**SECTION 221319**  
**SANITARY WASTE PIPING SPECIALTIES**

**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. Cleanouts.
  - 2. Miscellaneous sanitary drainage piping specialties.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS**

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
  - 1. Manufacturer
    - a. Jay R Smith
    - b. Josam Company
    - c. MIFAB Inc
    - d. Tyler Pipe
    - e. Watts
    - f. Zurn Industries
  - 2. Standard: ASME A112.36.2M.
  - 3. Size: Same as connected drainage piping
  - 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  - 5. Closure: Countersunk Raised-head, brass plug.
  - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Stainless Steel Exposed Cleanouts:



1. Manufacturer
  - a. Blucher
  - b. Josam
2. Standard: ASME A112.3.1.
3. Size: Same as connected drainage piping.
4. Body Material: Stainless steel tee with side cleanout as required to match connected piping.
5. Closure: Stainless steel plug with seal.

C. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturer
  - a. Jay R Smith
  - b. Josam Company
  - c. MIFAB
  - d. Sioux Chief Manufacturing
  - e. WATTS
  - f. Zurn Industries
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Outlet Connection: Threaded.
7. Closure: Brass plug with tapered threads.
8. Adjustable Housing Material: Match piping material or threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: Round.
11. Top-Loading Classification: Heavy Duty.
12. Riser: ASTM A74, Extra-Heavy Class, cast-iron drainage pipe fitting and riser to cleanout.

D. Stainless Steel Exposed Floor Cleanouts:

1. Manufacturer
  - a. Blucher
  - b. Josam Company
  - c. Kusel Equipment co
  - d. Zurn Industries
2. Standards: ASME A112.3.1; NSF listed.
3. Size: Same as connected branch.
4. Housing: Type 316 stainless steel.
5. Closure: Stainless steel with seal.

6. Riser: ASTM A74, Extra-Heavy Class, stainless steel drainage pipe fitting and riser to cleanout.
7. Body or Ferrule: Stainless steel.
8. Outlet Connection: Threaded.
9. Frame and Cover Material and Finish: Stainless steel.
10. Frame and Cover Shape: Round.
11. Top-Loading Classification: Heavy Duty.

E. Cast-Iron Wall Cleanouts:

1. Manufacturer
  - a. Jay R Smith
  - b. Josam Company
  - c. MIFAB
  - d. WATTS
  - e. Zurn Industries
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:
  - a. Brass.
  - b. Countersunk head.
  - c. Drilled and threaded for cover attachment screw.
  - d. Size: Same as cleanout size.
6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
7. Wall Access, Frame and Cover: Round, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.
- E. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- F. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- G. Install vent caps on each vent pipe passing through roof.
- H. Install traps on plumbing specialty drain outlets. Provide traps and/or vents on indirect wastes as required.

### 3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

### 3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
  - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

**END OF SECTION**

**SECTION 22 42 16.13**

**COMMERCIAL LAVATORIES**

SECTION 224216.13 - COMMERCIAL LAVATORIES

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. Vitreous-china, wall-mounted lavatories.
2. Manually operated lavatory faucets.
3. Supply fittings.
4. Waste fittings.
5. Lavatory supports.

B. Related Requirements:

1. Section 224300 "Healthcare Plumbing Fixtures" for healthcare lavatories.

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 lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - a. Servicing and adjustments of automatic faucets.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory - Vitreous China, Wall Mounted, with Back (L-1):
  - 1. Manufacturer:
    - a. American Standard
  - 2. Fixture:
    - a. Standard: ASME A112.19.2/CSA B45.1.
    - b. Type: For wall hanging.
    - c. Nominal Size: Rectangular, 20 by 18 inches
    - d. Faucet-Hole Punching: Three holes, 4-inch centers
    - e. Faucet-Hole Location: Top.
    - f. Color: White
    - g. Mounting Material: Chair carrier.
  - 3. Support: Type I, exposed-arm lavatory carrier
  - 4. Lavatory Mounting Height: ADA

2.2 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

- A. Lavatory – Self Rimming, Rectangular, Vitreous China, Counter Mounted (L-2)
  - 1. Manufacturer:
    - a. American Standard
  - 2. Fixture:
    - a. Standard: ASME A112.19.2/CSA B45.1.
    - b. Type: Self-rimming for above-counter mounting.
    - c. Nominal Size: Rectangular, 24 by 20 inches.
    - d. Faucet-Hole Punching: 4-inch centers.
    - e. Faucet-Hole Location: Top.
    - f. Color: White.
    - g. Mounting Material: Sealant.

2.3 MANUALLY OPERATED LAVATORY FAUCETS

- A. Manufacturer:
  - 1. Chicago Faucets
  - 2. Zurn
- B. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.
- C. Lavatory Faucets - Manual Type: Two-Handle Mixing,
  - 1. Standard: ASME A112.18.1/CSA B125.1.

2. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
3. Body Type: Centerset
4. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
5. Finish: Polished chrome plate
6. Maximum Flow Rate: 0.5 gpm
7. Mounting Type: Deck, exposed
8. Valve Handle(s): Wrist blade, 4 inches
9. Spout: Rigid, gooseneck type.
10. Spout Outlet: Laminar flow

#### 2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key or Wheel handle

#### 2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
  1. Size: NPS 1-1/2 by NPS 1-1/4
  2. Material:
    - a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch thick brass tube to wall; and chrome-plated, brass or steel wall flange.
    - b. Stainless steel, two-piece trap and swivel elbow with 0.012-inch thick stainless steel tube to wall, and stainless steel wall flange.

#### 2.6 LAVATORY SUPPORTS

- A. Lavatory Carrier
  1. Standard: ASME A112.6.1M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

### 3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.

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- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13



**SECTION 22 42 16**  
**COMMERCIAL SINKS**

**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. Handwash sinks.
- B. Related Requirements:
  - 1. Section 224300 "Healthcare Plumbing Fixtures" for healthcare fixtures.

**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 sinks.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For sinks to include in maintenance manuals.

**PART 2 - PRODUCTS**

**2.1 HANDWASH SINKS (S-1)**

- A. Handwash Sinks: Stainless steel, wall mounted.
  - 1. Manufacturer:
    - a. Elkay
  - 2. Fixture:

- a. Standards: ASME A112.19.3/CSA B45.4 and NSF/ANSI 2.
  - b. Type: Basin with radius corners, back for faucet, and support brackets.
  - c. Nominal Size: 17 by 16 by 5 inches.
- 3. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
  - 4. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
  - 5. Support: Type II sink carrier.
  - 6. Lavatory Mounting Height: Standard

## 2.2 SINK FAUCETS

- A. NSF Standard: Comply with NSF 372 for faucet-spout materials that will be in contact with potable water.
- B. Sink Faucets: Manual type, two lever handle mixing valve.
  - 1. Manufacturer:
    - a. Elkay
    - b. Just Manufacturing
    - c. Sloan
  - 2. Standard: ASME A112.18.1/CSA B125.1.
  - 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
  - 4. Body Type: Centerset.
  - 5. Body Material: Commercial, solid brass.
  - 6. Finish: Chrome plated.
  - 7. Handle(s): Wrist blade, 4 inches.
  - 8. Mounting Type: Deck
  - 9. Spout Type: Rigid gooseneck.
  - 10. Spout Outlet: Laminar flow

## 2.3 SUPPORTS

- A. Type II Sink Carrier:
  - 1. Standard: ASME A112.6.1M.

## 2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.

F. Risers:

1. NPS 1/2.
2. Chrome-plated, rigid-copper pipe or ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Install water-supply piping with stop on each supply to each sink faucet.
  1. Exception: Use ball valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."
  2. Install stops in locations where they can be easily reached for operation.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- F. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

- G. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.3 CONNECTIONS

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

### 3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

## SECTION 22 43 00

### HEALTHCARE PLUMBING FIXTURES

#### 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 healthcare fixtures and specialties:
  - 1. Healthcare water closets.
  - 2. Flushometer valves.
  - 3. Toilet seats.
  - 4. Supports.
- B. Related Requirements:
  - 1. Section 224216.13 "Commercial Lavatories" for lavatories for use in healthcare facilities, but not requiring special healthcare fixture attributes.
  - 2. Section 224216.16 "Commercial Sinks" for sinks for use in healthcare facilities, but not requiring special healthcare fixture attributes.

##### 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 fixtures.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For plumbing fixtures and faucets to include in operation and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Servicing and adjustments of flushometer valves

## PART 2 - PRODUCTS

### 2.1 HEALTHCARE WATER CLOSETS

- A. Healthcare Water Closets: Wall mounted back spud
  - 1. Manufacturer:
    - a. Americal Standard AFWALL
  - 2. Bowl:
    - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
    - b. Material: Vitreous china.
    - c. Type: Siphon jet.
    - d. Style: Flushometer valve with bedpan washer.
    - e. Height: ADA
    - f. Rim Contour: Elongated with bedpan lugs or slots.
    - g. Spud Size: NPS 1-1/2
  - 3. Water Closet Support: Water closet carrier.
  - 4. Water-Closet Mounting Height: ADA.

### 2.2 FLUSHOMETER VALVES

- A. Lever-Handle, Bedpan Washer Diaphragm Flushometer Valves.
  - 1. Standard: ASSE 1037.
  - 2. Minimum Pressure Rating: 125 psig.
  - 3. Features: Integral check stop, backflow-prevention device, and outlet-tube-mounted bedpan washer.
  - 4. Material: Brass body with corrosion-resistant components.
  - 5. Exposed Flushometer-Valve Finish: Chrome plated.
  - 6. Style: Exposed
  - 7. Minimum Inlet: NPS 1.
  - 8. Minimum Outlet: NPS 1-1/4, extended length.

### 2.3 TOILET SEATS

- A. Toilet Seats.
  - 1. Manufacturer
    - a. American Standard
    - b. Bemis
    - c. Olsonite
    - d. Zurn Industries
  - 2. Standard: IAPMO Z124.5.
  - 3. Material: Plastic with antimicrobial agent.
  - 4. Type: Commercial (heavy duty).
  - 5. Shape: Elongated rim, open front.
  - 6. Hinge: Check.
  - 7. Hinge Material: Noncorroding metal.
  - 8. Color: White.

## 2.4 SUPPORTS

### A. Water Closet Carrier: ASME A112.6.1M.

1. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

## 2.5 SUPPLY FITTINGS

### A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

### B. Standard: ASME A112.18.1/CSA B125.1.

### C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

### D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

## 2.6 WASTE FITTINGS

### A. Standard: ASME A112.18.2/CSA B125.2.

### B. Drain: Grid with NPS 1-1/2 DN 40 tailpiece.

### C. Trap:

1. Size: NPS 1-1/2.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

#### A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

#### B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.

#### C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

#### A. Install healthcare plumbing fixtures level and plumb according to roughing-in drawings.

#### B. Install supports, affixed to building substrate, for wall-mounted fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install counter-mounted fixtures in and attached to casework.
- D. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
1. Exception: Use ball or gate valve if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."
- E. Install flushometer valves on healthcare water closets.
- F. Install flushometer valves for accessible healthcare water closets, with lever handle mounted on wide side of compartment.
- G. Install toilet seats on healthcare water closets.
- H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts, if faucets are not available with required rates and patterns. Include adapters if required.
- I. Install laminar-flow, faucet-spout fittings in faucet spouts where laminar-flow fittings are specified.
- J. Install traps on fixture outlets.
1. Exception: Omit trap on fixtures with integral traps.
- K. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- L. Seal joints between healthcare plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- M. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with requirements for water piping specified in Section 221116 "Domestic Water Piping."
- C. Comply with requirements for soil and waste drainage piping and vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."



- D. Comply with requirements for atmospheric vent piping specified in Section 221316 "Sanitary Waste and Vent Piping."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

#### 3.4 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning healthcare plumbing fixtures, fittings, and controls.
- B. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

#### 3.5 CLEANING AND PROTECTION

- A. After installing healthcare plumbing fixtures, inspect and repair damaged finishes.
- B. Clean healthcare plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed fixtures and fittings.
- D. Do not allow use of healthcare plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224300



**SECTION 22 63 13**  
**MEDICAL GAS PIPING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes medical gas piping and related specialties for the following medical gas systems:
  - 1. Medical gas pressure systems:
    - a. Oxygen piping, designated "oxygen."
    - b. Medical compressed-air piping, designated "medical air."
  - 2. Medical gas suction systems:
    - a. Medical-surgical vacuum piping, designated "medical vacuum."
- B. Related Sections include the following:
  - 1. Division 23 Section "Meters and Gages" for thermometers and pressure gages.
  - 2. Division 23 Section "Medical Air and Vacuum Equipment" for compressed-air and vacuum equipment and related accessories.
  - 3. Division 23 Section "Mechanical Commissioning."

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. PTFE: Polytetrafluoroethylene plastic.
- C. PVC: Polyvinyl chloride plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Medical gas tubes and fittings.
  - 2. Medical gas valves and valve boxes.
  - 3. Medical gas manifolds.
  - 4. Medical gas service connections and pressure control panels.
  - 5. Medical gas service units. Include integral service connections.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Coordination Drawings: For medical gas systems. Include relationship to other services that serve same work area.
- D. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.
- E. Piping Material Certification: Signed by Installer certifying that medical gas piping materials comply with NFPA 99 requirements.
- F. Certificates of Shop Inspection and Data Report for Bulk Medical Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code.
- G. Qualification Data: For testing agency.
- H. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the Medical Gas Professional Healthcare Organization or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined C.E.C., Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- D. ASME Compliance: Fabricate and label bulk medical gas storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels."
- E. Comply with NFPA 50, "Bulk Oxygen Systems at Consumer Sites."
- F. Comply with 1998, "California Electrical Code."
- G. Comply with NFPA 99, 1996 Edition, "Health Care Facilities," for materials and installation.
- H. Comply with UL 498, "Attachment Plugs and Receptacles," for electrical service connections.
- I. Comply with UL 544, "Medical and Dental Equipment," for medical gas specialties.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with concrete work.
- B. Comprehensive Shop Drawings: Coordinate requirements of this section with comprehensive shop drawings required under Division 23, Section "Mechanical General Requirements." Submit a complete and comprehensive set of shop drawings in one package prior to material fabrication, order, and installation.
- C. Commissioning: Comprehensive Commissioning is an integral part of the work required. Provide comprehensive Commissioning of Mechanical systems in accordance with Division 23 Section "Mechanical Commissioning" and as specified elsewhere in these Specifications. The work of this Section includes cooperation and assistance with the Commissioning Authority to provide a fully Commissioned system. Review the commissioning requirements of the project and provide required support, including but not limited to, systems operation and adjustment, material and equipment submittals and documentation, systems start-up and testing, attendance at regular Commissioning meetings, cooperation with the Commissioning Authority and other trades in addressing and solving questions, conflicts and other issues that occur during the construction process.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPES, TUBES AND FITTINGS

- A. Hard Copper Tube: ASTM B 819, Type K, seamless, drawn-temper, medical gas tube that has been factory cleaned, purged, and sealed for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube.
  - 1. Fittings: Factory cleaned, purged, and bagged for oxygen service according to ASTM B 819 or field cleaned, purged, and bagged as specified in "Preparation" Article in Part 3.
    - a. Copper Pressure Fittings: ASME B16.22, wrought-copper solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
    - b. Cast-Copper-Alloy Flanges: ASME B16.24, Class 300.
    - c. Copper Unions: ASME B16.22 or MSS SP-123.
- B. Memory-Metal Couplings: Nickel-titanium, shape-memory-alloy, cryogenic compression fitting for joining copper tube without heat.
  - 1. Cleaning: Factory cleaned, purged, and bagged for oxygen service according to ASTM B 819 or field cleaned, purged, and sealed or bagged as specified in "Preparation" Article in Part 3.
  - 2. Manufacturers:
    - a. Tubetronics, Inc.
    - b. Or approved equal.

- C. Flexible Pipe Connectors: Corrugated-bronze inner tubing with bronze wire-braid covering and ends brazed to inner tubing.
  - 1. Cleaning: Factory cleaned, purged, and sealed or bagged for oxygen service according to ASTM B 819 or field cleaned, purged, and sealed or bagged as specified in "Preparation" Article in Part 3.
  - 2. Working-Pressure Rating: 250 psig minimum.
  - 3. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  - 4. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
  - 5. Manufacturers:
    - a. Flex-Hose Co., Inc.
    - b. Flexicraft Industries.
    - c. Hyspan Precision Products, Inc.
    - d. Metraflex, Inc.

#### 2.3 JOINING MATERIALS

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for joining materials not in this Section.
- B. Brazing Filler Metals: AWS A5.8, BCuP series alloys. Flux is prohibited unless used with bronze fittings.
- C. Threaded-Joint Tape: PTFE.
- D. Gasket Material: ASME B16.21, nonmetallic, flat, asbestos free, and suitable for oxygen service.

#### 2.4 MEDICAL GAS VALVES

- A. Valves, General: Factory cleaned for oxygen service and bagged.
  - 1. Exception: Factory cleaning and bagging are not required for valves for WAGD service.
- B. Copper-Alloy Ball Valves: MSS SP-110, 3-piece-body, full-port ball valve rated for 300-psig minimum working pressure; with chrome-plated brass ball, PTFE or TFE seats, blowout-proof stem, threaded or solder-joint ends, and locking-type handle designed for quarter turn between opened and closed positions.
  - 1. Manufacturers:
    - a. Beacon Medical Products.
    - b. Allied Healthcare Products, Inc.; Chemetron Div.
    - c. Hill-Rom.
- C. Stainless-Steel Ball Valves: MSS SP-72, split-body ball valve rated for 300-psig minimum working pressure; with stainless-steel ball, PTFE or TFE seats, blowout-proof stem, flanged ends, and locking-type handle.
  - 1. Manufacturers:
    - a. Cooper Cameron Corp.; Copper Cameron Valves Div.
    - b. KTM Products, Inc.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
- D. Bronze Check Valves: Straight-through-pattern, spring-loaded ball check valve; designed for 300-psig minimum working pressure.
- E. Cast-Iron Check Valves: MSS SP-71, Class 250, iron-body, bronze-trim, swing check valve, with flanged ends.
  - 1. Exception: Valves for vacuum service may be Class 125.
- F. Zone Valves: MSS SP-110, 3-piece-body, full-port copper-alloy ball valve rated for 300-psig minimum working pressure; with chrome-plated brass ball, PTFE or TFE seats, blowout-proof stem, threaded or solder-joint ends, and handle designed for quarter turn between opened and closed positions.
  - 1. Include union-type body with bolted swing-away center section.
  - 2. Include factory-installed ASTM B 819, Type K, copper-tube extensions with pressure gage for pressure systems and vacuum gage for vacuum systems.
  - 3. Manufacturers:
    - a. Beacon Medical Products.

- b. Allied Healthcare Products, Inc.; Chemetron Div.
    - c. Hill-Rom.
  - G. Zone Valve Boxes: Formed steel for recessed mounting, with holes for medical gas piping and anchors. Include boxes for single- or multiple-valve installation with pressure gage and in sizes to permit manual operation of valves.
    - 1. Interior Finish: Factory-applied white enamel.
    - 2. Cover Plate: Satin-chrome finish steel with frangible or removable windows.
    - 3. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
  - H. Zone Valve Boxes: Formed or extruded aluminum for recessed mounting, with holes for medical gas piping and anchors. Include boxes for single- or multiple-valve installation with pressure gage and in sizes to permit manual operation of valves.
    - 1. Interior Finish: Factory-applied white enamel.
    - 2. Cover Plate: Aluminum or extruded-anodized aluminum with frangible or removable windows.
    - 3. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
- 2.5 MEDICAL GAS SERVICE CONNECTIONS
  - A. Connection Devices: For specific medical gas pressure and vacuum services listed. Include roughing-in assemblies, finishing assemblies, and cover plates. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate. Furnish recessed-type units made for concealed piping, unless otherwise indicated.
    - 1. Manufacturers:
      - a. Beacon Medical Products.
      - b. Allied Healthcare Products, Inc.; Chemetron Div..
      - c. Hill-Rom.
    - 2. Roughing-in Assembly:
      - a. Steel outlet box for recessed mounting and concealed piping.
      - b. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
      - c. Double seals that will prevent gas leakage.
      - d. ASTM B 819, Type K, NPS 3/8 copper inlet or outlet tube brazed to valve with gas-service marking and tube-end dust cap.
    - 3. Finishing Assembly:
      - a. Brass housing with primary check valve.
      - b. Double seals that will prevent gas leakage.
      - c. Cover plate with gas-service label.
    - 4. Quick-Connect Service Connections: With keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use. Include the following:
      - a. Oxygen Service Connections: Keyed oxygen outlet.
      - b. Medical Air Service Connections: Keyed medical air outlet.
      - c. Medical Vacuum Service Connections: Keyed medical vacuum suction inlet.
    - 5. Wall Outlet Service Connection Cover Plates: One piece, stainless steel, with NAAMM AMP 503, No. 4 finish and permanent, color-coded, medical gas identifying label matching corresponding outlets.
- 2.6 TEST GAS
  - A. Description: Oil-free dry nitrogen complying with CGA P-9, for purging and testing of piping.
- 2.7 IDENTIFICATION
  - A. Refer to Division 23 Section "Mechanical Identification" for identification of piping, valves, gages, alarms, and specialties and for labels for bulk medical gas storage tanks.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Interruption of Existing Medical Gas Service: Do not interrupt medical gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary medical gas service according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed interruption of medical gas service.
  - 2. Do not proceed with interruption of medical gas service without Owner's written permission.
- B. Cleaning of Piping: If factory-cleaned and -capped medical gas piping is not available or if precleaned piping must be recleaned because of exposure, perform the following procedures:
  - 1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."
  - 2. Wash medical gas piping and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
    - a. Scrub to ensure complete cleaning.
    - b. Rinse with clean, hot water to remove cleaning solution.

### **3.2 PIPING APPLICATIONS**

- A. General: Use pipe, tube, fittings, and joining methods for medical gas piping systems according to the following applications:
- B. Joining New to Existing Copper Tubes NPS 2 and Smaller: Use memory-metal couplings.
- C. Joining of Dissimilar Metal Piping: Use dielectric fittings. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for dielectric fitting types.
  - 1. NPS 2 and Smaller: Use dielectric unions.
  - 2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
  - 3. NPS 5 and Larger: Use dielectric flange kits.
- D. Specialty and Equipment Flanged Connections: Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube.
  - 1. Exception: Use PVC companion flange with gasket for connection to PVC piping. Make joint same as that for PVC piping.
- E. Interior Medical Gas Pressure Piping: Use hard copper tube, copper pressure fittings, and brazed joints.
- F. Interior Medical Gas Piping at Pressures Greater Than 200 psig: Use ASTM B 819, Type K, hard copper tube, copper pressure fittings, and brazed joints.
- G. Interior Medical Vacuum Piping: Use hard copper tube, copper pressure fittings, and brazed joints.

### **3.3 PIPING INSTALLATION**

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Install supports and anchors according to Division 23 Section "Hangers and Supports" with spacing according to NFPA 99.
- C. Install thermometers and pressure gages according to Division 23 Section "Meters and Gages."
- D. Install flexible pipe connector at each connection to medical air and vacuum equipment.
- E. Purge medical gas piping, using oil-free dry nitrogen, after installing piping but before connecting to service connections, alarms, and gages.

### **3.4 JOINT CONSTRUCTION**

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
  - B. Brazed Joints: Use silver- or copper-phosphorus-composition filler metal and comply with CDA's "Copper Tube Handbook," Section VII, "Brazed Joints"; or AWS D10.13, "Recommended Practices for the Brazing of Copper Pipe and Tubing for Medical Gas Systems."
  - C. Arrange for coupling manufacturer's authorized representative to join new copper tube to existing copper tube with memory-metal couplings.
  - D. Join new copper tube to existing copper tube with memory-metal couplings. Follow coupling manufacturer's product-specific procedure.
- 3.5 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
  - B. Install piping adjacent to specialties and equipment to allow service and maintenance.
  - C. Connect medical gas piping to specialties, equipment, and accessories.
    - 1. Connection NPS 2 and Smaller: With shutoff valve and copper union.
    - 2. Connection NPS 2-1/2 and Larger: With shutoff valve and cast-copper-alloy flange.
  - D. Ground specialties and equipment according to Division 16 Section "Grounding and Bonding."
  - E. Connect wiring according to Division 16 Section "Conductors and Cables."
  - F. 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.
- 3.6 LABELING AND IDENTIFICATION
- A. Install identifying labels and devices for medical gas piping systems according to NFPA 99. Refer to Division 23 Section "Mechanical Identification" for labeling and identification materials.
  - B. Captions and Color-Coding: Use the following or similar medical gas captions and color-coding for medical gas piping products where required by NFPA 99:
    - 1. Oxygen: White letters on green background or green letters on white background.
    - 2. Medical Air: Black letters on yellow background.
    - 3. Medical Vacuum: Black letters on white background.
  - C. Label medical gas systems operating at other-than-standard pressure with system operating pressure.
- 3.7 FIELD QUALITY CONTROL
- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
  - B. Perform the following field tests and inspections and prepare test reports:
    - 1. Inspect, test, and certify completed medical gas systems according to requirements in NFPA 99. Inspect, test, and certify each medical gas piping system, including specialties, service connections, alarm system, safety devices, and source equipment.
    - 2. Provide oil-free dry nitrogen, medical gases, materials, and equipment required for testing.
    - 3. Level 1 Pressure Medical Gas Testing: Use oil-free dry nitrogen, unless otherwise indicated, and perform procedures and tests as indicated in NFPA 99 performance and testing paragraphs for piped gas systems. Include the following:
      - a. Performance Testing:
        - 1) Blow Down: Clear piping before connecting service connections or outlets.
        - 2) Initial Pressure Tests: Subject each piping section to test pressure of 1.5 times system working pressure, but not less than 150 psig, before attaching system components, after installing station outlets with test caps (if supplied) in place,



- and before concealing piping system. Maintain test until joints are examined for leaks by means of soapy water. Repair leaks with new materials and retest systems.
- 3) Cross-Connection Tests: Determine that no cross connections of piping systems exist. Disconnect all systems except system to be checked. Pressurize system to 50 psig. Verify that gas flow from service connections and outlets is only from system being checked. Repeat for each system. Verify correct labeling.
  - 4) Purge Tests: Perform heavy intermittent purging of piping and full-flow purging of service connections.
  - 5) Standing-Pressure Tests: Install assembled system components after testing individual systems as specified above. Subject systems to 24-hour standing-pressure test at 20% above normal line pressure. Verify that pressure differences comply with required calibration. Repair leaks with new materials and retest systems.
- b. System Verification:
- 1) Cross-Connection Tests: Repeat cross-connection test above or perform alternate tests with each gas at different pressure.
  - 2) Flow Tests: Perform flow test at each outlet.
  - 3) Valve Tests: Verify proper valve operation.
  - 4) Alarm Tests: Operate systems and verify proper warning indication of each medical gas piping system function.
  - 5) Piping Purity Tests: Test for dew point and hydrocarbons as compared to source gas.
  - 6) Final Tie-End Tests: Verify that above tests have been successfully performed.
  - 7) Operational Pressure Tests: Use designated system gases and test for pressure and flow.
  - 8) Medical Gas Concentration Tests: Test each gas for required concentration.
  - 9) Labeling: Verify correct labeling.
4. Level 1 Vacuum System Testing: Use oil-free dry nitrogen, unless otherwise indicated, and perform procedures and tests as indicated in NFPA 99 performance and testing paragraphs for piped vacuum systems. Include the following:
- a. Blow Down: Clear piping before connecting service connections or inlets.
  - b. Initial Pressure Tests: Subject each piping section to test pressure not less than 150 psig before attaching system components, after installing station outlets with test caps (if supplied) in place, and before concealing piping system. Maintain test until joints are examined for leaks by means of soapy water. Repair leaks with new materials and retest systems.
  - c. Initial Cross-Connection Tests: Determine that no cross connections of piping systems exist. Disconnect all systems except system to be checked. Pressurize system to 50 psig. Verify that gas flow from service connections and outlets is only from system being checked. Repeat for each system. Verify correct labeling.
  - d. Standing-Pressure Tests: Install assembled system components after testing individual systems as specified above. Subject systems to 24-hour standing-pressure test at not less than 60 psig.
  - e. Final Cross-Connection Tests: Repeat cross-connection test above or perform alternate tests with each system at different pressure.
  - f. Vacuum Tests: Verify functional operation of components.

- g. Valve Tests: Verify proper valve operation.
- h. Alarm Tests: Operate systems and verify proper warning indication of each medical gas piping system function.
- i. Labeling: Verify correct labeling.

END OF SECTION

**SECTION 23 05 00**  
**MECHANICAL GENERAL REQUIREMENTS**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. The General Conditions and Supplementary Conditions shall apply to and form part of this Division.

1.2 SUMMARY

- A. Work includes, but is not limited to, the following:
1. Labor, material, equipment, and transportation to complete the Work as shown on the drawings, specified herein and/or implied thereby.
  2. A requirement of the mechanical sections shall be to provide drains and final connections to systems and equipment.
  3. Work specified in Division 23 Sections.
  4. Coordination with work specified in Division 2; Division 21; Division 22; Division 26; Division 31
  5. It is the intent of the project that the installation be coordinated to provide a complete and usable facility.
- B. Work not included in this division:
1. Painting, except as hereinafter specified. See Division 9 for painting.
  2. Electrical, except for controls hereinafter specified. See Division 26 for electrical.

1.3 DEFINITIONS

- A. Unless otherwise specified, "all clarification from," "field direction by," "submittals to," "approved by," "processed by," "permission from," and like mentioned herein shall mean from/by/to Architect.
- B. "Provide" means furnish and install referenced item with all appurtenances.
- C. "Shall" indicates a mandatory requirement.
- D. "Air conditioning" is defined as the treatment and/or handling of any air to any degree by the systems shown on the drawings and herein specified and is not restricted to refrigerated cooling.

1.4 DELIVERY AND STORAGE OF MATERIALS

- A. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage from any cause whatever, and provide adequate and proper storage facilities during the progress of the work. Replace all damaged and defective work, material, or equipment prior to filing application for final acceptance. Properly protect all openings to equipment, piping, ductwork, accessories, etc. from dirt, dust, and debris prior to and during installation of the work. Ductwork and piping stored at the jobsite shall be covered and capped to protect from dirt, dust, debris, fire proofing, etc.

## 1.5 CODES AND STANDARDS

- A. Work and materials shall be in full accordance with the latest rules and regulations of the Office of Statewide Health Planning and Development (OSHPD), the State Fire Marshal; the California Electric Code (NEC); the California Plumbing Code; the California Mechanical Code; California Administrative Code, Title 24, (CAL/OSHA); Local Building Codes; Vol. II of the Uniform Building Code; Volume I and II of the California Building Code; SMACNA "Guidelines for Seismic Restraints of Mechanical Systems"; and other applicable codes, laws or regulations of bodies lawfully empowered and having jurisdiction over this project. Nothing in the plans or specifications shall be construed to permit work not conforming to these codes. When codes conflict with one another, comply with the larger, higher or more restrictive standards without additional costs.

## 1.6 PERMITS

- A. Obtain all permits, patent rights, and licenses that are required for the performing of this work by all laws, ordinances, rules and regulations, or orders of any officer and/or body having jurisdiction. Provide all notices necessary in connection therewith, and pay all fees relating thereto and all costs and expenses incurred on account thereof. No work shall be covered before inspection by the jurisdictional authorities and observation by the Architect or the owner's designated representatives.

## 1.7 EXPLANATION AND PRECEDENCE OF DRAWINGS

- A. Drawings and specifications are intended to be read together so that any work mentioned in one and not the other shall be executed the same as if mentioned in both.
- B. For purposes of clearness and legibility, drawings are essentially diagrammatic. Approximate only. The contractor shall review the drawings, including architectural, civil, structural, mechanical, plumbing, fire protection, electrical, and other related elements of the construction documents, to identify specific requirements for off-sets, transitions, anchorages, and attachments necessary to provide the mechanical systems as diagrammatically indicated in the construction documents.
- C. The design drawings intended arrangements are intended to be diagrammatic and do not indicate required offsets, attachments and fittings necessary to route and install the exact ductwork and piping. Fabricate and install based upon actual field measurements. Do not use unstated dimensions from BIM design model for creation of fabrication drawings. Coordinate detailed routing with other trades and building structure and architecture and submit comprehensive shop drawings. Indicated locations and arrangements were used for basic pipe and ductwork sizing, expansion, pump sizing, and other design considerations. Install piping and ductwork generally as indicated on diagrammatic drawings and provide offsets and fittings to accommodate and coordinate with building structure and other trades. Identify all arrangements on comprehensive shop drawings and submit for review and approval. The size and location of equipment is drawn to scale wherever possible. Contractor shall make use of data in the contract documents and shall verify this information at the building site. Refer to field survey and shop drawing requirements
- D. Where the contract specifications and/or drawings are in conflict, obtain clarification of such during bidding. Where addenda for clarification of such is not timely, base the bid on the higher standards or more restrictive requirements; prior to fabrication, obtain written clarification.

- E. The drawings indicate required size and points of termination of pipes, and suggest proper routes to conform to structure, avoid obstructions, and preserve clearances. It is not intended that drawings indicate necessary offsets, transitions, fittings, supports, or other components required to accommodate the required routing. The Contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, conceal work, preserve headroom, and keep openings and passageways clear, without further instructions or costs to the Government.
- F. It is intended that apparatus be located symmetrical and aligned with architectural elements. Refer to architectural plans and details in completing the correlating work.
- G. The Contractor shall study all drawings and specifications including, and not limited to, architectural, civil, structural, mechanical, plumbing, fire protection, and electrical to determine conflict with ordinances and statutes. Conflicts, errors or omissions shall be reported in writing, and changes shall be included in the as-built drawings and the additional work performed at no additional cost to the Government.
- H. Submittal of bid shall indicate the Contractor has examined the site and drawings and has included required allowances in his bid. Contractor's Bid shall include all costs for the required mechanical work, coordination, drawings, and changes as outline above. No allowance or additional compensation shall be allowed after Bid for any error or work resulting from Contractor's failure to visit job site and to review drawings and specifications as require herein
- I. OSHPD CHANGE ORDER APPROVAL: Contractor shall perform a full field survey and provide fully coordinated shop drawings per sections below. Any proposed deviations from the OSHPD approved contract drawings due to unforeseen field conditions or contractor proposed changes shall not be performed until approved by the design of professional of record and OSHPD through approved change order documents. Any proposed deviations from the contract drawings shall be fully identified in the contractor's shop drawings. Contractor shall allow 45 days in schedule from approval of deviations by the design professional of record to the approval by OSHPD of the deviations in a change order document/ACD. Contractor shall not proceed without an approved ACD. Any further changes found in the field due to unforeseen conditions during construction after the approval of the coordinated shop drawings shall require further OSHPD approved change orders. Contractor shall allow additional 45 days in schedule for each additional change order/ACD.

#### 1.8 RECORD DRAWINGS

- A. In addition to requirements for shop drawings specified elsewhere, provide and maintain on the job one complete set of blue line prints of the record drawings for all the mechanical and plumbing work. Carefully record on this set of prints, work including piping, valves, etc., which is installed differently from that indicated in the specifications and on the drawings; locate dimensionally from fixed points. The depth and location shall be indicated for all plugged wyes, tees and capped lines.
- B. These record drawings shall be continuously kept up-to-date and shall be available for inspection at all times. Existing lines discovered shall be indicated on these drawings.
- C. At completion of work, provide a neat and legible reproducible set of these up-to-date record drawings which shall be individually signed and dated by the Contractor and the job inspector stating that the documents are accurate and reflect the as-built condition of the construction.
- D. Record drawings shall be submitted for acceptance and approval to the Architect and Mechanical Engineer before final certificate of acceptance will be issued.

- E. Record drawings shall show the exact location of all valves, balancing devices, access doors, and control sensors and devices.

#### 1.9 CUTTING AND PATCHING

- A. Perform all cutting and fitting required for work of this division in rough construction of the building. Obtain permission of the Structural Engineer prior to cutting any structural building elements.
- B. All patching of finished construction of building shall be performed under the sections of specifications covering these materials by the trades at no additional cost to the Owner.
- C. All cutting of concrete work by Contractor shall be by core drilling or concrete saw. No cutting or coring shall be done without first obtaining the permission of the Architect and Owner.
- D. All patching of existing surfaces shall match existing material and finish.

#### 1.10 DAMAGE BY LEAKS

- A. Contractor shall be responsible for damage to the grounds, walks, roads, buildings, finishes, surfaces, materials, equipment, piping systems, electrical systems and their equipment and contents, caused by leaks in the piping systems being installed or having been installed herein. Contractor shall repair at his expense all damage so caused. All repair work shall be done as directed by the Architect and Owner.

#### 1.11 EMERGENCY REPAIRS

- A. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond or relieving the Contractor of his responsibilities.

#### 1.12 LOCATIONS

- A. Coordinate in advance of the work, requirements for openings, equipment maintenance clearances, offsets, supports, expansion and contraction, recesses, and chases in the walls, partitions, equipment housekeeping pads, framing or openings. Should furnishing this information be neglected, delayed, or incorrect and additional cutting is found to be required, the cost of same shall be borne by the Contractor. Nothing in this paragraph shall be construed to relieve the Contractor of the responsibility for providing and paying for the required core drilling and openings in existing work.
- B. Diagrammatic Indications on Drawings are:
  - 1. Approximate only. The contractor shall review the drawings, including architectural, civil, structural, mechanical, plumbing, fire protection, electrical, and other related elements of the construction documents, to identify specific requirements for off-sets, transitions, anchorages, and attachments necessary to provide the mechanical systems as diagrammatically indicated in the construction documents.
  - 2. At various locations shown distorted for clarity.
- C. Exact Locations Shall:
  - 1. Be as required for proper installation in available space.
  - 2. Avoid interference with architectural, electrical, fire protection, structural and other construction features.
  - 3. Be coordinated with the work of other trades toward the general purpose of having the work progress rapidly and smoothly without interference between one trade and another.
  - 4. Preserve headroom and keep openings and passageways clear.

5. Have a neat arrangement symmetrical to the building lines, light and tile patterns.
6. Be reasonably accessible for suspended ceiling areas for maintenance from the floor below. Adequate access for all equipment, valves, and other items requiring maintenance, adjustment, and/or observation shall be provided.

#### 1.13 SUPPORTS, EQUIPMENT PADS, STAGING, ETC.

- A. Construction supports required for the proper installation of equipment shall be in accordance with the drawings, manufacturer's requirements, seismic requirements, and applicable codes. Check architectural and structural drawings for equipment pads by others. Provide staging, scaffolds, platforms, ladders, and similar facilities required to properly install the work.

#### 1.14 INTERRUPTION OF UTILITIES

- A. This project includes elements of work which will require disconnection and modification of existing systems, with resultant outages. These outages must be strictly limited and controlled. No outage affecting any portion of the existing facilities will be allowed without specified written authorization by the Owner, Architect, and Engineer. Coordinate all work with project phasing requirements to maintain access and operation of portions of the work outside the specific area of the Phase under construction.
- B. The Contractor shall schedule and coordinate all interruptions of utilities with the Architect and Owner within 30 days after award of contract. The Contractor shall submit to the Owner a schedule of proposed interruptions. At least 144 hours prior to the interruption, the contractor shall submit a request indicating the proposed date and duration of interruption, the work to be accomplished, the areas which will be affected and a proposed contingency plan to be followed in the event that normal service or facilities cannot be restored on schedule. Do not commence work until the time, date, and contingency have been approved in writing by the Architect and Owner.
- C. Provide all labor and materials necessary to restore services on a contingency basis should normal service or facilities not be restored on schedule.
- D. Preparatory work associated with each interruption shall be performed during normal work hours. The actual interruption required for tie-in shall be performed between 8 P.M. and 5 A.M or at another time as required to minimize the impact on the operational activities of the hospital. Maximum shutdown during this period of any system shall be four hours.

#### 1.15 SUBSTITUTIONS

- A. If substitutions of materials, controls, or equipment impact or require any changes in the architectural, structural, mechanical, plumbing, electrical, other equipment, or other work from that specified and shown on the drawings, the extra cost of the equipment or architectural, structural, mechanical, plumbing, electrical or other work shall be the responsibility of the Contractor requesting the substitution. All substitutions shall be approved by the Architect before purchase by the contractor.
- B. If the Contractor proposes substitutions of any equipment specified herein or on the drawings, it shall be the Contractor's responsibility to obtain approval from the Architect for such equipment as well as approval for anchorage of such equipment from the Architect, Structural Engineer, Mechanical Engineer, and governing approval agencies All costs required for such approval shall be the responsibility of the Contractor requesting the substitution.

#### 1.16 PREPARATION OF SUBMITTALS

- A. Refer to Division 1. In addition to the requirements of Division 1, comply with the additional requirements specified herein.

- B. Prior to commencement of work and in accordance with the General Requirements, submit for review six copies of proposed equipment and material submittals. The Contractor shall verify the delivery dates are compatible with the specified construction schedule; and verify the equipment is sized to accommodate the conditions specified, will fit within the available space, and allow for required clearances for service and maintenance. Submittals shall include manufacturer's names and model numbers, specific drawing and specification paragraph reference, and shall comply with specifications and drawings. Contractor's submittal shall be taken as evidence that the required review, coordination and verification has been completed.
- C. Provide formal submittal to the Architect. Review of the formal submittal is only for general conformance with design concept of project and general compliance with the information given in the contract documents. The Contractor is responsible for confirmation and correlation of the dimensions, quantities, and sizes for information that pertains to fabrication methods or construction techniques, and for coordination of work of all trades. Any deviations from the Drawings and Specifications shall be clearly and completely indicated (by a separate letter) in the formal submittals. Reviewed Submittals shall not relieve the Contractor of responsibility for errors or deviations or the requirement for compliance with the contract documents.
1. Where specific model numbers and/or manufacturers are specified or shown, it is the intent of the contract documents to procure the specified item(s). Alternate equipment may not be used unless data is submitted for consideration as a substitution in accordance with General Requirements and this section.
  2. Model numbers used may not indicate all features, options, or other specific components required for this specific installation. Modify the specified models to comply with the requirements, as specified or shown.
  3. Product Data for Proposed Substitutions:
    - a. Submit copies of complete data, with drawings and samples as appropriate, including:
      - 1) Comparison of the qualities of the proposed substitution with that specified.
      - 2) Changes required in other elements of the work because of the substitution.
      - 3) Effect on construction schedule.
      - 4) Cost data comparing the proposed substitution with the product specified.
      - 5) Availability of maintenance service and source of replacement materials.
      - 6) Reference to three projects similar to this where such equipment is installed and operating to two or more years. All references shall include the name and telephone number of personnel point of contact who is familiar with the operation of the referenced item.
    - b. Acceptance of substitutions is entirely at the discretion of the Architect and the Owner.
- D. Formal submittals shall be complete with catalog data and information properly marked to indicate equality of material (where substitution is allowed and desired) and adequacy in capacity and performance to meet minimum capacities or performance as specified or indicated. Arrange the submittals in the same sequence as these Specifications and indicate the Section and specific Paragraph number (in the upper right-hand side with tabs) for which each submittal page is intended. Incomplete submittals shall be rejected.



- E. Do not fabricate, order, or deliver materials or equipment until formal submittals have been approved. Where material or equipment is used without such permission, it is deemed that the material or equipment shall be in complete compliance with drawings and specifications. Where such materials or equipment are found to be not in compliance with the contract documents, the said items shall be removed and replaced with complying materials or equipment without additional cost.
- F. Submittals shall be bound and shall include, at a minimum, the following:
  - 1. Complete bill of materials listing materials and equipment furnished.
  - 2. Catalog cut sheets of each component being provided. Each item included in the submittal shall be highlighted or otherwise specifically identified. Any items that do not specifically apply to the submittal shall be crossed out.
  - 3. Provide completed black-line shop drawings of equipment detailing all field connection points.
  - 4. Dimensions, clearance requirements, weights, and capacities.
  - 5. Indication/certification of compliance with indicated or specified codes and standards.
  - 6. Wiring and control diagrams showing control interface as applicable.
  - 7. Warranty sheets.
  - 8. Pressure drops, velocities, temperatures, gages, and other requirements as applicable.
- G. All submittals shall be reviewed and approved by the Commissioning Authority prior to submittal to assure design intent is met and proper coordination is maintained.
- H. Contractor shall incur all costs for time spent by Engineer for review of more than two submittals on each item. Costs shall be based on Engineer's hourly billing rate schedule at the time of review. Rate schedule available upon request. Engineer shall invoice the contractor upon completion of review and shall be paid by the contractor within 30 days of date of invoice. Failure to remit payment will withdraw approval (if any) of the submittals in question.

#### 1.17 SHOP DRAWINGS

- A. Conditions indicated in the design drawings are based upon available as-built drawings and limited above ceiling surveys. Ductwork, piping and equipment shown represent estimated best possible location based on limited survey access available. Refer to division 01 for complete project BIM shop drawing requirements.
- B. Perform a full site survey within 15 days of contract award. Survey shall be all inclusive of all areas under scope of work and beyond for full systems installation. Notify the engineer of record and owner of any conditions that differ or have changed from the design drawings. The site survey shall be performed to determine detailed phasing plan, and create fully coordinated comprehensive shop drawings.
- C. Comprehensive Shop Drawings: Proceed with the preparation of comprehensive 3-Dimensional shop drawings immediately upon receiving an authorization to proceed for the project. Shop drawings shall be originally prepared by the contractor. Provide minimum 1/4" scale shop drawings completed within a 3-dimensional model in Revit, AutoCAD, Navisworks or similar program. Submit a complete and comprehensive set of Shop Drawings in one package within 60 days of contract award and prior to material fabrication, order, and installation. Comprehensive Shop Drawings shall include but are not limited to:
  - 1. Architectural, structural, electrical, plumbing, and other work specified under Divisions outside Division 23.

2. Drawings showing full overlay and coordination with other trades included delegated seismic design drawings utilizing approved OSHPD OPM.
  3. Duct and pipe (mechanical and plumbing) elevations.
  4. Double line ductwork and double line piping (mechanical and plumbing) for sizes 4" and larger. Piping smaller than 4" shall be single line.
  5. Actual size of purchased equipment.
  6. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work including.
  7. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
  8. Access panels including ceiling panels.
  9. Access clearances for equipment.
  10. Actual locations of diffusers, registers, and grilles.
  11. Actual locations of manual volume dampers including extractors and splitters.
  12. Locations of structural penetrations such as beams.
  13. Actual location of control panels and power connections to equipment.
  14. Color coded duct and piping based on material used.
  15. Label and tag schedule for equipment.
  16. Duct and piping off-sets and transitions to clear building architecture, structure, electrical, fire protection, or other tight or congested areas. Includes existing architecture, structure, electrical, fire protection,
  17. Existing building utilities being relocated to accommodate design.
  18. Room temperature sensor locations.
  19. Point of connection to utilities outside the building.
  20. Gridlines.
- D. Coordinate with other trades including delegated seismic shop drawings.
- E. Coordinate with existing conditions.
- F. Include signatures on the shop drawings from all applicable trades confirming all coordination has occurred and the submitted shop drawings are free from conflicts.
- G. Submit a clash detection log from the software utilized indicated here are no clashes.
- H. Submit a copy of shop drawings to General Contractor for distribution to other trades, including but not limited to the electrical, structural and fire sprinkler trades.
- I. All shop drawings shall be reviewed and approved by the Commissioning Authority prior to submittal to assure design intent is met and proper coordination is maintained.
- J. Prior to fabrication and upon receiving approval from commissioning authority, submit a complete set of shop drawings at one time to the mechanical engineer.

#### 1.18 COMMISSIONING

- A. Comprehensive Commissioning is an integral part of the work required. Provide comprehensive Commissioning of Mechanical systems in accordance with Division 01 and 23 Section "Commissioning" and as specified elsewhere in these Specifications. The work required for all Division 22 and 23 Sections includes cooperation and assistance with the Commissioning Authority to provide a fully Commissioned system. Review the commissioning requirements of the project and provide required support, including but not limited to, systems operation and adjustment, material and equipment submittals and documentation, systems start-up and testing, attendance at regular Commissioning meetings, cooperation with the Commissioning Authority and other trades in addressing and solving questions, conflicts and other issues that occur during the construction process.

## 1.19 ELECTRICAL REQUIREMENTS

### A. Coordinate the following items with Division 26:

1. Power wiring
2. Power Supply Voltage Requirements
3. Safety switches
4. Combination controllers
5. Disconnect switches
6. Motor starters
7. Circuit breakers
8. Motor-control equipment forming part of motor control centers or switchgear assemblies
9. Electrical connections of the mechanical equipment to the electrical power source shall be coordinated with and provided under Division 26.

## 1.20 MOTORS

- ### A.
- Before order is placed for electrical devices, the Contractor shall check with the Electrical contractor and verify requirements as to type, mounting, and current characteristics as well as to any special delivery instructions.

## 1.21 TESTS

- ### A.
- Make tests required by legally constituted authorities, required under other Division 23 sections, and as listed below.

1. Tests shall be made in the presence of the Owner or his representative, a duly authorized inspector, and the Commissioning Authority. The Owner or his representative shall be notified 5 days before tests are made.
2. Concealed work and insulated work shall remain uncovered until required testing has been performed and approved by the Owner. If work to be tested is covered before the approval of the Owner or his authorized representative has been obtained, it shall be uncovered for testing at the Contractor's expense.
3. Obtain required documents of certification indicating approval, acceptance, and compliance with the requirements of all administrative authorities having jurisdiction over the work. No final payment shall be made until all such certificates are delivered to the Owner.
4. Furnish labor, materials, instruments, and bear other costs in connection with all tests.
5. Piping systems, except as hereinafter noted, shall be given hydrostatic (with water) test of a least 150% of the maximum operating pressure but no less than 150 psig.
6. Before making test, remove or valve off from the system, gauges, traps, and other apparatus or equipment which may be damaged by test pressure.
7. Install a calibrated test pressure gauge in the system to observe any loss in pressure. Maintain the required test pressure for a sufficient length of time to enable an inspection to be made of all joints and connections, but not less than 4-hours. Perform tests after installation and prior to acceptance.
8. Prepare and submit a valve line-up diagram and verify that the entire system is subject to test pressure. Indicate line-up and area to be tested on a system diagram and submit to the Engineer, the Owner, and the Commissioning Authority.
9. Final pressures at the end of the test period shall be no more or less than that caused by expansion or contraction of the test medium due to temperature changes.

10. After tests have been made and leaks repaired, clean and flush systems as hereinafter specified. Water piping shall be left under supply main pressure for the balance of the construction period.
11. Additional tests for mechanical, plumbing, and fire protection systems are specified within their own section. Equipment and ductwork system tests are specified in the test and balance section.
12. Provide necessary provisions and tests for maintaining the operational condition and cleanliness of existing systems as well as systems provided under this Contract.

#### 1.22 LABOR AND MATERIALS

- A. Labor shall be carefully skilled for this kind of work, and under the direction of a competent foreman.
- B. Materials shall be new, in perfect condition and of domestic manufacturer. Materials for similar uses shall be of the same type and manufacturer.
- C. Equipment shall bear the manufacturer's label showing performance characteristics as well as model numbers. Identifying size number shall be given only when it is not practicable or customary to show performance characteristics.
- D. Valves, pipe, fittings, etc., shall bear the manufacturer's name or trademark and model.
- E. Unless otherwise specified herein, equipment and fixtures shall be installed in accordance with the manufacturer's recommendations, including recommended service and removal clearances.

#### 1.23 PROTECTION AND CLEAN-UP

- A. Protection: Provide for the safety and good condition of materials and equipment until final acceptance of the Architect and Owner. Protect materials and equipment from dirt, dust, debris, and damage from any cause whatever, and provide adequate and proper storage facilities during the progress of the work. Properly protect all openings to equipment, piping, ductwork, accessories, etc. from dirt, dust, and debris prior to, during, and after installation of the work. Ductwork and piping stored at the jobsite shall be covered and capped to protect from dirt, dust, debris, fire proofing, etc. Replace all damaged and defective material, equipment or work precedent to filing application for final acceptance.
- B. Cleaning:
  1. Unless a more stringent requirement is specified, thoroughly clean all parts of the piping, ductwork, fixtures, apparatus, and equipment. All parts shall be vacuumed and thoroughly cleaned of dirt, dust, debris, cement, plaster and other materials, and all grease and oil spots removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out and cleaned.
  2. Exposed rough metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left in clean condition to receive painter's finish. Where factory prime coat has been damaged, the work shall be repaired and restored under this section.

#### 1.24 ACCESS PANELS

- A. Access Doors and Panels:
  1. Wherever volume dampers, fire dampers, smoke fire dampers, controls, valves or other items or parts of the installation which require periodic inspection or adjustments are concealed by permanent non-removable construction, an access door or panel shall be provided. Rating of access doors and panels shall

be determined by the rating of the wall or ceiling in which panel is installed. Types to be as approved and as appropriate for the surface and construction in which it is installed. Verify all locations with Architect and other trades for access doors and related components requiring access prior to installation.

2. Access doors and panels shall be of sufficient size and shall be located properly to assure access and service to the intended item.

#### 1.25 MAINTENANCE, OPERATION INSTRUCTION

- A. General: Thoroughly instruct the Owner's operators in every detail of operation of the system. Provide the Owner with a list of all equipment, giving the manufacturer's name, model number, serial number, parts list and complete internal wiring diagrams. All directions for operation furnished by the manufacturer shall be carefully saved and turned over to the Owner, together with written sequence of operation, operating and maintenance instructions for each system and its equipment. Instruction shall consist of a minimum of three 8-hour periods over consecutive days and shall be 30% classroom and 70% at site location. Coordinate scheduling of instruction times and the number of attendees with Owner's operators. If required training is not enough for the operators to feel competent to operate/maintain equipment additional training may be provided to the owner and no additional cost. All MEP training shall be videotaped
- B. Specific Data: Submit four complete sets of the following data to the Owner for approval prior to acceptance of the installation, complete and at one time; (partial or separate data will not be accepted) data shall consist of the following:
  1. Valve Directory: Indicating valve number, location, function, and normal operating position for each valve. Include diagrams and plans indicating valve locations.
  2. Color code schedule for piping, ductwork, labeling, and other items or systems specified to be color coded.
  3. Equipment: List of name plates, including name plate data.
  4. Manufacturer's Literature: Copies of manufacturer's instructions for operation and maintenance of all mechanical equipment, including replacement parts lists and drawings. Mark or highlight brochure literature indicating the models, sizes, capacities, curve operating points, etc., in a manner to clearly indicate the equipment installed. Remove all pages or sheets from the bulletin and catalogs that do not pertain to equipment installed on the project.
  5. Written Instructions: Typewritten instructions for operation and maintenance of the system composed of OPERATING INSTRUCTIONS, MAINTENANCE INSTRUCTIONS, and a MAINTENANCE SCHEDULE.
    - a. OPERATING INSTRUCTIONS shall contain a brief description of the system. Adjustments requiring the technical knowledge of the service agency personnel shall not be included in the operating instructions. The fact such adjustments are required, however, shall be noted.
    - b. MAINTENANCE INSTRUCTIONS shall list each item of equipment requiring inspection, lubrication, or service and describe the performance of such maintenance.
    - c. MAINTENANCE SCHEDULE shall list each item of equipment requiring maintenance, shall show the exact type of maintenance on every component of each item of equipment, and shall show when each item of equipment should be inspected or services.
  6. Instructions: Operating personnel shall be instructed in the operation of the system in accordance with typewritten, approved instructions.

- C. Binders: Provide complete sets of the above data in loose-leaf ring-type binders with permanent covers, with identification on front and on spine.

#### 1.26 SPECIAL REQUIREMENTS

- A. During the guarantee period and as directed by the Owner, make any additional tests, adjustment, etc., that may be required and correct any defects or deficiencies arising from operation of the systems. Operational tests shall be made during both heating and cooling seasons and on all systems.
- B. Completion:
  - 1. The entire mechanical system shall be commissioned in accordance with ASHRAE Guideline 1-1996 and the requirements of this specification. The Commissioning process shall occur throughout the construction with periodic reports submitted monthly or more frequently when required. A final commissioning report shall be submitted by the Contractor and approved by the Owner, Architect, and Mechanical Engineer prior to final acceptance of the work.
  - 2. When the installation is complete and adjustments specified herein have been made, the system shall be operated for a period of one week, during which time it shall be demonstrated to the Owner or his representative as being completed and operating in conformance with these specifications. The Contractor shall schedule all work so that this time period, which is to confirm a "bug-free" system, will occur before the total project is accepted for substantial completion by Owner.
  - 3. The work hereunder shall not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, valve directories, piping identification code directory, nameplates, and Commissioning specified herein have been approved and properly posted in the building.

#### 1.27 WARRANTY / GUARANTEE

- A. Warranty/guarantee that materials, apparatus, and equipment furnished and installed under the mechanical division of these specifications shall be new and free from all defects. Should any defects develop, within two years (unless a longer period is listed in other sections of the specifications) from the date of final acceptance by the owner or from the date of certificate of substantial completion, whichever is earlier, due to inferior or faulty materials and/or workmanship, the trouble shall be corrected by this Contractor without expense to the Owner. Any defective materials or inferior workmanship noticed at the time of installation or during the guarantee period shall be corrected immediately to the entire satisfaction of the Owner.
- B. The work shall be installed of such materials and in such a manner that:
  - 1. The operation of all parts of the system shall be noiseless to the extent that no objectionable sound of operation will be heard outside of the rooms enclosing the apparatus or equipment.
  - 2. Apparatus or equipment shall operate in accordance with detailed specifications covering each item.
  - 3. Contractor shall, at his own expense, make any adjustments or changes required to produce a condition of quietness satisfactory to the Engineer or his representative. Such adjustments or changes shall not reduce the performance or quantities called for on the drawings.
  - 4. Contractor shall guarantee that his installation of all materials and equipment will meet the performance requirements of these specifications and that all equipment will deliver the specified or required capacities.
  - 5. The Owner reserves the right to make temporary or emergency repairs as necessary to keep equipment in operating condition without voiding the

guarantee contained herein or relieving the Contractor of his responsibilities during the guarantee period.

6. Contractor shall be responsible for all damage to any part of the premises caused by leaks or break in pipe lines, fixtures or equipment furnished and installed under his contract for a period of two years after date of acceptance of the project by Owner. He shall replace in kind, at his own expense, any and all items so damaged to the complete satisfaction of the Owner.

**END OF SECTION**





**SECTION 230523.12**  
**BALL VALVES FOR HVAC PIPING**

**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. Brass ball valves.
  - 2. Bronze ball valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, and weld ends.
  - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

**PART 2 - PRODUCTS**

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded-end valves.
  - 2. ASME B16.1 for flanges on iron valves.
  - 3. ASME B16.5 for flanges on steel valves.
  - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 5. ASME B16.18 for solder-joint connections.
  - 6. ASME B31.1 for power piping valves.
  - 7. ASME B31.9 for building services piping valves.

- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Refer to HVAC valve schedule articles for applications of valves.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
  - 2. Handlever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
  - 1. Include 2-inch stem extensions.
  - 2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
  - 3. Memory stops that are fully adjustable after insulation is applied.
- I. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRASS BALL VALVES

- A. Brass Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:
  - 1. Manufacturer
    - a. Jomar Valve
    - b. Kitz Coporation
    - c. Watts
  - 2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: 150 psig.
    - c. CWP Rating: 600 psig.
    - d. Body Design: Three piece.
    - e. Body Material: Forged brass.
    - f. Ends: Threaded.
    - g. Seats: PTFE.
    - h. Stem: Stainless steel.
    - i. Ball: Stainless steel, vented.
    - j. Port: Full.

## 2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, Three-Piece with Full Port Stainless-Steel Trim:
  - 1. Manufacturer
    - a. Apollo Flow Controls
    - b. Hammond Valve
    - c. Milwaukee Valve Company

- d. NIBCO INC
  - e. WATTS
2. Description:
- a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Three piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE.
  - h. Stem: Stainless steel.
  - i. Ball: Stainless steel, vented.
  - j. Port: Full.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

#### **3.2 VALVE INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

#### **3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 3 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Steel Piping, NPS 3 and Smaller: Threaded ends.

3.4 HEATING-WATER AND CHILLED WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 and Smaller: Brass or bronze ball valves, three-piece with stainless-steel trim, full port, threaded or solder-joint ends.

**END OF SECTION**

## SECTION 230529

### HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

#### 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 pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment stands.
8. Equipment supports.

###### B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" for duct hangers and supports.

##### 1.3 ACTION SUBMITTALS

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

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

- C. Delegated-Design Submittal: Trapeze hangers, wall supports, and floor supports shall comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of hangers.
2. Include design calculations for designing hangers.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

## **PART 2 - PRODUCTS**

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers, wall supports, floor supports, and equipment supports.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

### 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pre-galvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated, or epoxy powder coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe and Tube Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel or stainless steel.

### 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 METAL FRAMING SYSTEMS

### A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturer
  - a. ABB
  - b. Atkore International
  - c. Eaton (B-line)
  - d. Flex-Strut
  - e. G-Strut
  - f. Haydon Corporation
  - g. MIRO Industries
  - h. Wesanco
2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel or stainless steel, Type 316 channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
8. Metallic Coating: Pregalvanized G90.
9. Paint Coating: Green epoxy, acrylic, or urethane.
10. Plastic Coating: PVC.

### B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturer
  - a. Anvil International
  - b. Carpenter & Paterson, Inc
  - c. Empire Industries, Inc
  - d. Gripple Inc
  - e. MIRO Industries
  - f. nVent
  - g. PHD Manufacturing
  - h. RectorSeal HVAC
  - i. Rooftop Support Systems
2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

4. Channels: Continuous slotted carbon-steel or stainless steel channel with inturred lips.
5. Channel Width: Select for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon-steel or stainless steel.
8. Metallic Coating: Pre-galvanized G90.
9. Paint Coating: Green epoxy, acrylic, or urethane.
10. Plastic Coating: PVC.

## 2.5 THERMAL-HANGER SHIELD INSERTS

### A. Manufacturer

1. Buckaroos, Inc
2. Carpenter & Paterson, Inc
3. KB Enterprise
4. National Pipe Hanger Corporation
5. nVent
6. Pipe Shield
7. Piping Technology & Products
8. Rilco Manufacturing Co
9. Value Engineered Products

- B. Insulation-Insert Material for Cold Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 1. Manufacturer

- a. Hilti, Inc
- b. ITW Ramset/Red Head
- c. MKT Fastening LLC
- d. Simpson Strong

- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.



1. Manufacturer
  - a. Eaton (B-Line)
  - b. Empire Tool and Manufacturing
  - c. Hilti, Inc
  - d. ITW Ramset/Red Head
  - e. MKT Fastening, LLC
2. Indoor Applications (Except Mechanical Rooms and Wet Areas): Zinc-coated steel.
3. Mechanical Rooms and Wet Areas: Stainless Steel
4. Outdoor Applications: Stainless steel.

## 2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof or grade-mounted piping.
- B. Compact Pipe Stand:
  1. Manufacturer
    - a. MIRO Industries
    - b. PHP Systems/Design
    - c. RectorSeal HVAC
    - d. Rooftop Support Systems
  2. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  3. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  4. Hardware: Galvanized steel or polycarbonate.
  5. Accessories: Protection pads.
- C. Low-Profile, Single Base, Single-Pipe Stand:
  1. Manufacturer
    - a. MIRO Industries
    - b. PHP Systems/Design
    - c. Rooftop Support Systems
  2. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
  3. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  4. Vertical Members: Two, galvanized-steel, continuous-thread 1/2-inch rods.
  5. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.
  6. Pipe Supports: Roller, Strut clamps, Clevis hanger or Swivel hanger.
  7. Hardware: Galvanized steel.
  8. Accessories: Protection pads.
  9. Height: 12 inches above roof.

- D. 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.

## 2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.9 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Non-staining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## **PART 3 - EXECUTION**

### 3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. 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.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured only when specifically permitted by the project Structural Engineer. Use operators that are licensed

- by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and within three pipe diameters of changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

- b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1 inch.

### 3.6 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 a minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless steel pipe hangers and stainless steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
  - a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use mechanical-expansion anchors instead of building attachments in concrete construction. Powder-actuated fasteners are only permitted when specifically identified by the project Structural Engineer.

**END OF SECTION**



## SECTION 230548

### VIBRATION AND SEISMIC CONTROLS FOR HVAC

#### 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. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient support.
9. Resilient pipe guides.
10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
14. Snubbers.
15. Restraints - rigid type.
16. Restraints - cable type.
17. Restraint accessories.
18. Post-installed concrete anchors.
19. Concrete inserts.
20. Vibration isolation equipment bases.
21. Restrained isolation roof-curb rails.

###### B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.

##### 1.3 DEFINITIONS

- A. Designated Seismic System: An HVAC component that requires design in accordance with ASCE/SEI 7, Ch. 13, and for which the Component Importance Factor is greater than 1.0.
- B. IBC: International Building Code.

- C. OSHPD: Office of Statewide Health Planning and Development (for the State of California owned and regulated medical facilities).

#### 1.4 ACTION SUBMITTALS

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

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Include load rating for each wind-force-restraint fitting and assembly.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-[ and wind-force-]restraint component.
4. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by OSHPD.
5. Annotate to indicate application of each product submitted and compliance with requirements.
6. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

- B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

- C. Delegated-Design Submittal:

1. For each seismic-restraint and wind-load protection device, including seismic-restrained mounting, pipe-riser resilient support, snubber, seismic restraint, seismic-restraint accessory, concrete anchor and insert, and restrained isolation roof-curb rail that is required by this Section or is indicated on Drawings, submit the following:
  - a. Seismic and Wind-Load Restraint, and Vibration Isolation Base Selection: Select vibration isolators, seismic and wind-load restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
  - b. 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 by professional engineer that riser system was examined for excessive stress and that none exists.
  - c. Concrete Anchors and Inserts: Include calculations showing anticipated seismic and wind loads. Include certification that device is approved by an NRTL for seismic reinforcement use.
  - d. Seismic Design Calculations: Submit all input data and loading calculations prepared under "Seismic Design Calculations" Paragraph in "Performance Requirements" Article.
  - e. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.
  - f. Qualified Professional Engineer: All designated-design submittals for seismic- and wind-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.

2. Seismic- and Wind-Restraint Detail Drawing:
  - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
  - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
  - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
3. All delegated-design submittals for seismic- and wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
4. Product Listing, Preapproval, and Evaluation Documentation: By OSHPD showing maximum ratings of restraint items and basis for approval (tests or calculations).
5. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Seismic Qualification Data: Provide special certification for designated seismic systems as indicated in ASCE/SEI 7-16 Paragraph 13.2.2, "Special Certification Requirements for Designated Seismic Systems" for all Designated Seismic Systems identified as such on Drawings or in the Specifications.
  1. Provide equipment manufacturer's written certification for each designated active mechanical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7 and AHRI 1270, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction or ASCE/SEI 7-16.
  2. Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7-16.
  3. Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by a licensed professional engineer.

- F. Wind-Force Performance Certification: Provide special certification for HVAC components subject to high wind exposure and impact damage and designated on Drawings or in the Specifications to require wind-force performance certification.
  - 1. Provide equipment manufacturer's written certification for each designated HVAC device, stating that it will remain in place and operable following the design wind event and comply with all requirements of authorities having jurisdiction.
  - 2. Provide manufacturer's written certification for each designated louver, damper, or similar device, stating that it will remain in place and protect opening from penetration of windborne debris and comply with all requirements of authorities having jurisdiction.
  - 3. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7, and be acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic- and Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: an agency acceptable to authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic and wind- load control system.
  - 1. Seismic and Wind-Load Performance: Equipment shall withstand the effects of earthquake motions and high wind events determined in accordance with ASCE/SEI 7-16.
- B. Seismic Design Calculations:
  - 1. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-16. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to in this subparagraph is the edition intended as reference throughout the Section Text.
    - a. Data indicated below to be determined by Delegated-Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
    - b. Coordinate seismic design calculations with wind-load calculations for equipment mounted outdoors. Comply with requirements in other Sections in addition to those in this Section for equipment mounted outdoors.
    - c. Coordination with seismic and wind loading design parameters with the structural design documents.
  - 2. Calculation Factors, ASCE/SEI 7-16, Ch. 13 - Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-16 unless otherwise noted from, the project structural drawings.

- a. Horizontal Seismic Design Force  $F_p$ : Value is to be calculated by Delegated-Design Contractor using Equation 13.3-1. Factors below must be obtained for this calculation:
- 1)  $S_{DS}$  = Spectral Acceleration: See structural drawings. Value applies to all components on Project.
  - 2)  $a_p$  = Component Amplification Factor: See structural Drawing.
  - 3)  $I_p$  = Component Importance Factor: See structural Drawing.
  - 4)  $W_p$  = Component Operating Weight: For each component. Obtain by Delegated-Design Contractor from each component submittal.
  - 5)  $R_p$  = Component Response Modification Factor: See Drawing structural Schedule.
  - 6)  $z$  = Height in Structure of Point of Attachment of Component for Base: Determine from Project Drawings for each component by Delegated-Design Contractor. For items at or below the base, "z" shall be taken as zero.
  - 7)  $h$  = Average Roof Height of Structure for Base: Determine from Project Drawings by Delegated-Design Contractor.
- b. Vertical Seismic Design Force: Calculated by Delegated-Design Contractor using method explained in ASCE/SEI 7-16, Paragraph 13.3.1.2.
- c. Seismic Relative Displacement  $D_{pl}$ : Calculate by Delegated-Design Contractor using methods explained in ASCE/SEI 7-10, Paragraph 13.3.2. Factors below must be obtained for this calculation:
- 1)  $D_p$  = Relative Seismic Displacement that Each Component Must Be Designed to Accommodate: Calculate by Delegated-Design Contractor in accordance with ASCE/SEI 7-10, Paragraph 13.3.2.
  - 2)  $I_e$  = Structure Importance Factor: See structural drawing. Value applies to all components on Project.
  - 3)  $\delta_{xA}$  = Deflection at Building Level x of Structure A: See structural Drawing.
  - 4)  $\delta_{yA}$  = Deflection at Building Level y of Structure A: See structural Drawing.
  - 5)  $\delta_{yB}$  = Deflection at Building Level y of Structure B: See structural Drawing.
  - 6)  $h_x$  = Height of Level x to which Upper Connection Point Is Attached: Determine for each component by Delegated-Design Contractor from Project Drawings and manufacturer's data.
  - 7)  $h_y$  = Height of Level y to which Upper Connection Point Is Attached: Determine for each component by Delegated-Design Contractor from Project Drawings and manufacturer's data.
  - 8)  $\Delta_{aA}$  = Allowable Story Drift for Structure A: See structural Drawing.
  - 9)  $\Delta_{aB}$  = Allowable Story Drift for Structure B: See structural Drawing.
  - 10)  $h_{sx}$  = Story Height Used in the Definition of Allowable Drift  $\Delta_a$ : See structural Drawings.
- d. Component Fundamental Period  $T_p$ : Calculated by Delegated-Design Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.3. Factors below must be obtained for this calculation:
- 1)  $W_p$  = Component Operating Weight: Determined by Contractor from Project Drawings and manufacturer's data.

- 2)  $g$  = Gravitational Acceleration: 32.17 fps<sup>2</sup>.
- 3)  $K_p$  = Combined Stiffness of Component, Supports, and Attachments: Determined by delegated-design seismic engineer.

C. Wind-Load Design Calculations:

1. Perform calculations to obtain force information necessary to properly select wind-load-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-16. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to in this subparagraph is intended as referenced throughout the Section Text unless otherwise noted.
  - a. Data indicated below that are specific to individual pieces of equipment must be obtained by Contractor and must be included in individual component submittal packages.
  - b. Coordinate design wind-load calculations with seismic load calculations for equipment requiring both seismic and wind-load reinforcement. Comply with requirements in other Sections in addition to those in this Section for equipment mounted outdoors.
2. Design wind pressure " $p$ " for external sidewall-mounted equipment such as louvers is to be calculated by Delegated-Design Contractor using methods in ASCE/SEI 7-16, Ch. 30. Perform calculations in accordance with one of the following, as applicable:
  - a. PART 1: Low-Rise Buildings.
  - b. PART 2: Low-Rise Buildings (Simplified).
  - c. PART 3: Buildings with " $h$ " less than 60 feet.
  - d. PART 4: Buildings with " $h$ " greater than 60 feet and less than 160 feet.
  - e. PART 5: Open Buildings.
3. Design wind pressure " $p$ " for rooftop equipment is to be calculated by Delegated-Design Contractor using methods in ASCE/SEI 7-16, Ch. 30, PART 6: Building Appurtenances and Rooftop Structures and Equipment.
  - a.  $q_z$  = Velocity Pressure: Value calculated by delegated wind-load design Contractor using methods detailed in ASCE/SEI 7-16 Section 26.10.1 or other source approved by authorities having jurisdiction.
  - b.  $q_h$  = Velocity Pressure: Value calculated by delegated wind-load design Contractor using methods detailed in ASCE/SEI 7-16 Section 26.10.1 or other source approved by authorities having jurisdiction.

D. Consequential Damage: Provide additional seismic restraints for suspended HVAC components or anchorage of floor-, roof-, or wall-mounted HVAC components as indicated in ASCE/SEI 7-16 so that failure of a non-essential or essential HVAC component will not cause failure of any other essential architectural, mechanical, or electrical building component.

E. Fire/Smoke Resistance: Seismic- and wind-load-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.

F. Component Supports:

1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.

2. All component support attachments must comply with force and displacement resistance requirements of ASCE/SEI 7-16 Section 13.6.

## 2.2 ELASTOMERIC ISOLATION PADS

### A. Elastomeric Isolation Pads:

1. Manufacturer
  - a. Ace Mountings co
  - b. California Dynamics
  - c. Isolation Technology
  - d. Kinetics Noise Control
  - e. Korfund
  - f. Mason Industries
  - g. Novia
  - h. Nvent
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
5. Surface Pattern: Smooth, ribbed, or waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.
  - a. Surface Pattern: Smooth, ribbed, or waffle pattern.
  - b. Infused nonwoven cotton or synthetic fibers.

## 2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

### A. Restrained Elastomeric Isolation Mounts:

1. Manufacturer
  - a. Ace Mountings co
  - b. California Dynamics
  - c. Isolation Technology
  - d. Kinetics Noise Control
  - e. Korfund
  - f. Mason Industries
  - g. Novia
  - h. Nvent
2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

- a. Housing: Cast-ductile iron or welded steel.
- b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.4 RESTRAINED-SPRING ISOLATORS

### A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint.

1. Manufacturer
  - a. Ace Mountings co
  - b. California Dynamics
  - c. Isolation Technology
  - d. Kinetics Noise Control
  - e. Korfund
  - f. Mason Industries
  - g. Novia
  - h. Nvent
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
  - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Top plate with threaded mounting holes.
  - c. Internal leveling bolt that acts as blocking during installation.
3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.5 HOUSED-RESTRAINED-SPRING ISOLATORS

### A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing.

1. Manufacturer
  - a. Ace Mountings Co
  - b. California Dynamics
  - c. Isolation Technology
  - d. Kinetics Noise Control
  - e. Korfund
  - f. Mason Industries
  - g. Novia
  - h. Nvent



2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
  - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
  - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.6 PIPE-RISER RESILIENT SUPPORT

- A. All-Directional, Acoustical Pipe Anchor Consisting of Two Steel Tubes Separated by a Minimum 1/2-inch- Thick Neoprene.
  1. Manufacturer
    - a. California Dyanamic Coroporation
    - b. Kinetics Noise Control
    - c. Mason Industries, Inc
  2. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  3. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

## 2.7 RESILIENT PIPE GUIDES

- A. Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-inch- Thick Neoprene.
  1. Manufacturer
    - a. California Dyanamic Coroporation
    - b. Kinetics Noise Control
    - c. Mason Industries, Inc
  2. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## 2.8 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.
  1. Manufacturer
    - a. Ace Mountings Co
    - b. California Dynamics Corporation
    - c. Kietics Noise Control

- d. Mason Industries, Inc
  - e. Novia
  - f. nVent
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
  9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.9 SNUBBERS

### A. Manufacturers

1. Kinetics Noise Control
2. Mason Industries, Inc
3. nVent

### B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be seismically prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for 2015 or 2018 IBC.
2. Preset Concrete Inserts: Seismically prequalified in accordance with ICC-ES AC446 testing.
3. Anchors in Masonry: Design in accordance with TMS 402.
4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

## 2.10 RESTRAINTS - RIGID TYPE

### A. Manufacturers

1. Atkoe International
2. California Dynamics Corporation
3. Eaton (B-line)
4. Hilti, Inc
5. Isolation Technology

6. nVent
7. TOLCO

B. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53 steel pipe as per NFPA 13, or other rigid steel brace member. Includes 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; rated in tension, compression, and torsion forces.

## 2.11 RESTRAINTS - CABLE TYPE

### A. Manufacturers

1. Eaton (B-line)
2. Loos & Co
3. nVent

B. Seismic-Restraint Cables: ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.

C. Restraint cable assembly with cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

## 2.12 RESTRAINT ACCESSORIES

### A. Manufacturer

1. Atkore International
2. Eaton (B-line)
3. Hilti, Inc.
4. Loos & Co.
5. Mason Industries, Inc
6. nVent
7. Tolco

B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Non-metallic stiffeners are unacceptable.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. 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.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## 2.13 POST-INSTALLED CONCRETE ANCHORS

### A. Mechanical Anchor Bolts:

1. Manufacturer

- a. Atkore International
  - b. Eaton
  - c. Hilti, Inc
  - d. Mason Industries, Inc.
  - e. Power fasteners
2. 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 for anchor and as tested according to ASTM E488.
- B. Adhesive Anchor Bolts:
- 1. Manufacturer
    - a. Atkore International
    - b. Eaton (B-line)
    - c. Hilti, Inc
    - d. Mason Industries, Inc
    - e. Power Fasteners
    - f. Simpson Strong-Tie Co
  - 2. Drilled-in and capsule anchor system containing PVC 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.
- C. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-16, Ch. 13.
- 1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
  - 2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.
- D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp that is not vibration isolated.
- 1. Undercut expansion anchors are permitted.
- 2.14 CONCRETE INSERTS
- A. Manufacturer
- 1. Atkore International
  - 2. Eaton (B-line)
  - 3. Hilti, Inc.
  - 4. Mason Industries, Inc.
  - 5. Power Fasteners
  - 6. Simpson Strong-Tie
- B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC466 testing.

- C. Comply with ANSI/MSS SP-58.

## 2.15 VIBRATION ISOLATION EQUIPMENT BASES

### A. Manufacturer

1. California Dynamics Corporation
2. Kinetics Noise Control
3. Mason Industries, Inc
4. Novia
5. nVent

### B. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
  - a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

### C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
  - a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

## 2.16 RESTRAINED ISOLATION ROOF-CURB RAILS

### A. Manufacturer

1. California Dynamics Corporation
2. Kinetics Noise Control
3. Novia
4. nVent
5. Thybar Corporation

### B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.

### C. Upper Frame: To provide continuous support for equipment and to be captive to resiliently resist seismic and wind forces.

### D. Lower Support Assembly: To be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. Lower support assembly to have a means for attaching to building structure and a wood nailer for attaching roof materials, and to be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Mount adjustable, restrained-spring isolators on elastomeric vibration isolation pads and provide

access ports, for level adjustment, with removable waterproof covers at all isolator locations. Locate isolators so they are accessible for adjustment at any time during the life of the installation without interfering with integrity of roof.

- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. 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 of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. 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 OSHPD.
- B. Hanger-Rod Stiffeners: Install 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 is adequate to carry present and future static, wind load, and seismic loads within specified loading limits.

#### **3.3 INSTALLATION OF VIBRATION-CONTROL, WIND-LOAD CONTROL, AND SEISMIC-RESTRAINT DEVICES**

- A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Devices Schedules, where indicated on Drawings, or where Specifications indicate they are to be installed on specific equipment and systems.
- B. Provide seismic-restraint and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Seismic-Restraint Devices Schedules, where indicated on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- D. Installation of vibration isolators, wind-load restraints, must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- E. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- F. Equipment Restraints:
  - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

3. Install seismic-restraint, and wind-load-restraint devices using methods approved by OSHPD that provides required submittals for component.
- G. Piping Restraints:
1. Comply with requirements in MSS SP-127.
  2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  3. Brace a change of direction longer than 12 feet.
- H. Install seismic- and wind-load-restraint cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install seismic-restraint devices using methods approved OSHPD that provides required submittals for component.
- J. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- K. 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.
- L. 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.
- M. Mechanical Anchor Bolts:
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 structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed 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-Type Anchor Bolts: 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-Type Anchor Bolts: 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 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Provide flexible connections in piping systems where they cross structural seismic joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties" for piping flexible connections.

### 3.5 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

- A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

- B. Coordinate dimensions of steel equipment rails and bases, concrete inertia bases, and restrained isolation roof-curb rails with requirements of isolated equipment specified in this and other Sections. Where dimensions of these bases are indicated on Drawings, dimensions may require adjustment to accommodate actual isolated equipment.

### 3.6 ADJUSTING

- A. Adjust isolators after 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.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to 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. Tests and Inspections:
  - 1. Perform tests and inspections with the assistance of a factory-authorized service representative.
  - 2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
  - 4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 5. Test no fewer than four of each type and size of installed anchors and fasteners selected by owner.
  - 6. Test to 90 percent of rated proof load of device.
  - 7. Measure isolator restraint clearance.
  - 8. Measure isolator deflection.
  - 9. Verify snubber minimum clearances.
  - 10. Test and adjust restrained-air-spring isolator controls and safeties.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Units will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

**END OF SECTION**



## SECTION 230553

### IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

#### 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. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL REQUIREMENTS FOR IDENTIFICATION

- A. Manufacturer:
  - 1. Seton
  - 2. Brady
  - 3. Brimar

##### 2.2 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Letter Color: White.
  - 3. Background Color: Black.
  - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

### 2.3 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

### 2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

### 2.5 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater

viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

- E. Fasteners: Stainless-steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

## 2.6 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch or stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link chain or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.

## 2.7 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Safety-yellow background with black lettering.

## **PART 3 - EXECUTION**

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 25 feet along each run.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
  - 1. Heating Water Piping: White letters on a safety-green background

### 3.5 DUCT LABEL INSTALLATION

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue For cold-air supply ducts.
  - 2. Yellow For hot-air supply ducts.
  - 3. Green For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Hot Water: 1-1/2 inches, round.
  - 2. Valve-Tag Colors:
    - a. Potable and Other Water: White letters on a safety-green background.

- b. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

### 3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION**

## SECTION 230593

### TESTING, ADJUSTING, AND BALANCING FOR HVAC

#### 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. Balancing Air Systems:
  - a. Constant-volume air systems.
  - b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
  - a. Variable-flow hydronic systems.
3. Testing, Adjusting, and Balancing Equipment:
  - a. Motors.
  - b. Heat-transfer coils.
4. Testing, adjusting, and balancing existing systems and equipment.
5. Sound tests.
6. Vibration tests.
7. Duct leakage tests.
8. Control system verification.

##### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

##### 1.4 PREINSTALLATION MEETINGS

- A. TAB Conference: If requested by the Owner, conduct a TAB conference at the Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
  1. Minimum Agenda Items:
    - a. The Contract Documents examination report.
    - b. The TAB Plan.
    - c. Needs for coordination and cooperation of trades and subcontractors.

d. Proposed procedures for documentation and communication flow.

#### 1.5 ACTION SUBMITTALS

##### A. Sustainable Design Submittals:

1. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

#### 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

#### 1.7 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

B. TAB Specialists Qualifications: Certified by NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

## 1.8 FIELD CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## **PART 2 - PRODUCTS (Not Applicable)**

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible, and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.



- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete, and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. Suitable access to balancing devices and equipment is provided.
  - 2. Hydronics:
    - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
    - b. Piping is complete with terminals installed.
    - c. Water treatment is complete.
    - d. Systems are flushed, filled, and air purged.
    - e. Strainers are pulled and cleaned.
    - f. Control valves are functioning per the sequence of operation.
    - g. Shutoff and balance valves have been verified to be 100 percent open.
    - h. Pumps are started and proper rotation is verified.
    - i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
    - j. Variable-frequency controllers' startup is complete, and safeties are verified.
    - k. Suitable access to balancing devices and equipment is provided.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111 or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
  - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

### 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

- b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses, close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  - 2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 4. Obtain approval from Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  - 1. Measure airflow of submain and branch ducts.
  - 2. Adjust submain and branch duct volume dampers for specified airflow.
  - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
  - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  - 2. Measure inlets and outlets airflow.
  - 3. Adjust each inlet and outlet for specified airflow.
  - 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
  - 1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
  - 2. Re-measure and confirm that total airflow is within design.
  - 3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
  - 4. Mark all final settings.
  - 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  - 6. Measure and record all operating data.
  - 7. Record final fan-performance data.

### 3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
  - 1. Check liquid level in expansion tank.
  - 2. Check highest vent for adequate pressure.
  - 3. Check flow-control valves for proper position.
  - 4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
  - 5. Verify that motor starters are equipped with properly sized thermal protection.
  - 6. Check that air has been purged from the system.

### 3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Adjust pumps to deliver total design gpm.
  - 1. Measure total water flow.
    - a. Position valves for full flow through coils.
    - b. Measure flow by main flow meter, if installed.
    - c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
  - 2. Measure pump TDH as follows:
    - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    - c. Convert pressure to head and correct for differences in gage heights.
    - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
  - 3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- B. Adjust flow-measuring devices installed in mains and branches to design water flows.
  - 1. Measure flow in main and branch pipes.
  - 2. Adjust main and branch balance valves for design flow.
  - 3. Re-measure each main and branch after all have been adjusted.
- C. Adjust flow-measuring devices installed at terminals for each space to design water flows.
  - 1. Measure flow at terminals.
  - 2. Adjust each terminal to design flow.

3. Re-measure each terminal after it is adjusted.
  4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
  5. Perform temperature tests after flows have been balanced.
- D. For systems with pressure-independent valves at terminals:
1. Measure differential pressure and verify that it is within manufacturer's specified range.
  2. Perform temperature tests after flows have been verified.
- E. For systems without pressure-independent valves or flow-measuring devices at terminals:
1. Measure and balance coils by either coil pressure drop or temperature method.
  2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
- F. Verify final system conditions as follows:
1. Re-measure and confirm that total water flow is within design.
  2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
  3. Mark final settings.
- G. Verify that memory stops have been set.

### 3.8 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Phase and hertz.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter size and thermal-protection-element rating.
  8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

### 3.9 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
  2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
  3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
  4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.

5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

### 3.10 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

### 3.11 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
  1. Entering- and leaving-water temperature.
  2. Water flow rate.
  3. Dry-bulb temperature of entering and leaving air.
  4. Airflow.

### 3.12 SOUND TESTS

- A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at 5 locations as designated by the Architect.
- B. Instrumentation:
  1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
  2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels and measuring the equivalent continuous sound pressure level (LEQ).
  3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
  4. The accuracy of the sound-testing meter shall be plus or minus one decibel.
- C. Test Procedures:
  1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
  2. Equipment should be operating at design values.
  3. Calibrate the sound-testing meter prior to taking measurements.
  4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
  5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) and 31.5 Hz to 4000 Hz (RC) with the equipment off.
  6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) and 31.5 Hz to 4000 Hz (RC) with the equipment operating.
  7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.

8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:
  - a. Location.
  - b. System tested.
  - c. dBA reading.
  - d. Sound pressure level in each octave band with equipment on and off.
2. Plot sound pressure levels on NC and RC worksheet with equipment on and off.

### 3.13 VIBRATION TESTS

- A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than 10 .

B. Instrumentation:

1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:

1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
4. Record CPM or rpm.
5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:

1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."

4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

### 3.14 DUCT LEAKAGE TESTS

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.

### 3.15 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
  1. Verify temperature control system is operating within the design limitations.
  2. Confirm that the sequences of operation are in compliance with Contract Documents.
  3. Verify that controllers are calibrated and function as intended.
  4. Verify that controller set points are as indicated.
  5. Verify the operation of lockout or interlock systems.
  6. Verify the operation of valve and damper actuators.
  7. Verify that controlled devices are properly installed and connected to correct controller.
  8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
  9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

### 3.16 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
  1. Measure and record the operating speed, airflow, and static pressure of each fan.
  2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  3. Check the refrigerant charge.
  4. Check the condition of filters.
  5. Check the condition of coils.
  6. Check the operation of the drain pan and condensate-drain trap.
  7. Check bearings and other lubricated parts for proper lubrication.
  8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
  1. New filters are installed.
  2. Coils are clean and fins combed.
  3. Drain pans are clean.
  4. Fans are clean.



5. Bearings and other parts are properly lubricated.
  6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
  2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  4. Balance each air outlet.

### 3.17 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Air Outlets and Inlets: Plus or minus 5 percent or 10 cfm.
  2. Heating-Water Flow Rate: Plus or minus 5 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### 3.18 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.19 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
  3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
  2. Fan curves.
  3. Manufacturers' test data.
  4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB specialist.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.

6. Balancing stations.
  7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Filter static-pressure differential in inches wg.
    - f. Preheat-coil static-pressure differential in inches wg.
    - g. Cooling-coil static-pressure differential in inches wg.
    - h. Heating-coil static-pressure differential in inches wg.
    - i. Outdoor airflow in cfm.
    - j. Return airflow in cfm.
    - k. Outdoor-air damper position.
    - l. Return-air damper position.
- F. Apparatus-Coil Test Reports:
1. Coil Data:
    - a. System identification.
    - b. Location.
    - c. Coil type.
    - d. Number of rows.
    - e. Fin spacing in fins per inch o.c.
    - f. Make and model number.

- g. Face area in sq. ft..
  - h. Tube size in NPS.
  - i. Tube and fin materials.
  - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm.
  - b. Average face velocity in fpm.
  - c. Air pressure drop in inches wg.
  - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
  - e. Return-air, wet- and dry-bulb temperatures in deg F.
  - f. Entering-air, wet- and dry-bulb temperatures in deg F.
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
  - h. Water flow rate in gpm.
  - i. Water pressure differential in feet of head or psig.
  - j. Entering-water temperature in deg F.
  - k. Leaving-water temperature in deg F.
  - l. Refrigerant expansion valve and refrigerant types.
  - m. Refrigerant suction pressure in psig.
  - n. Refrigerant suction temperature in deg F.
  - o. Inlet steam pressure in psig.
- G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
  - 2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.

- c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.
- H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
- 1. Report Data:
    - a. System and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft..
    - g. Indicated airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.

### 3.20 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner.
- B. Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
  - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  - 3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

### END OF SECTION

**SECTION 230713**  
**DUCT INSULATION**

**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 insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, concealed return located in unconditioned space.
  - 3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
- B. Related Sections:
  - 1. Section 230719 "HVAC Piping Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

## 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## 1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## **PART 2 - PRODUCTS**

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," and "Indoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturer
    - a. Owens-Corning
    - b. Johns-Manville
    - c. Knauf Insulation Manson Insulation Inc
    - d. 3M
    - e. Unifrax
    - f. Thermal Ceramic
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturer
    - a. Owens-Corning

- b. Johns-Manville
- c. Knauf Insulation Manson Insulation Inc
- d. 3M
- e. Unifrax
- f. Thermal Ceramic

## 2.2 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Manufacturer
    - a. Childers Brand
    - b. Eagle Bridges
    - c. Foster Brand
    - d. Mon-Eco Industries
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Manufacturer
    - a. Childers Brand
    - b. Eagle Bridges
    - c. Foster Brand
    - d. Mon-Eco Industries

## 2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.
  - 1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
  - 4. Color: White.
- C. Vapor-Retarder Mastic: Solvent based; suitable for outdoor use on below ambient services.
  - 1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
  - 2. Service Temperature Range: Minus 50 to plus 220 deg F.
  - 3. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Water-Vapor Permeance: ASTM E96, greater than 1.0 perm at manufacturer's recommended dry film thickness.



2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Color: White.

## 2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  2. Service Temperature Range: 0 to plus 180 deg F.
  3. Color: White.

## 2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.
- B. ASJ Flashing Sealants and Vinyl Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: White.

## 2.6 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 C1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
  4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

## 2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.

6. 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 C1136.
  1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.

## 2.8 SECUREMENTS

- A. Bands:
  1. Stainless Steel: ASTM A167 or ASTM A240/A240M, Type 316; 0.015-inch-thick, 3/4 inch wide with wing seal or closed seal.
  2. 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- diameter shank, length to suit depth of insulation indicated.
  2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  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. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030-inch-thick by 2 inches square.
    - b. Spindle: Stainless steel, fully annealed, 0.106-inch- 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. 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. Baseplate: Galvanized carbon-steel sheet, 0.030-inch-thick by 2 inches square.
  - b. Spindle: Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - c. Adhesive-backed base with a peel-off protective cover.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
  - D. Wire: 0.062-inch soft-annealed, stainless steel.
- 2.9 CORNER ANGLES
- A. Stainless-Steel Corner Angles: 0.024-inch-thick, minimum 1 by 1-inch, stainless steel according to ASTM A167 or ASTM A240/A240M, Type 316.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- ### 3.4 PENETRATIONS
- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 078413 "Penetration Firestopping."

D. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not over compress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over compress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  1. Indoor, concealed supply and outdoor air.
  2. Indoor, concealed return located in unconditioned space.
  3. Indoor, concealed, cryogenic vent.
  4. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  5. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
- B. Items Not Insulated:
  1. Factory-insulated flexible ducts.
  2. Factory-insulated plenums and casings.
  3. Flexible connectors.
  4. Vibration-control devices.
  5. Factory-insulated access panels and doors.

### 3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, rectangular, round and flat-oval, supply-air duct and plenum insulation shall be one of the following:
  1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
- B. Concealed, rectangular, round and flat-oval, return-air duct and plenum insulation shall be one of the following:
  1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
  2. Mineral-Fiber Board: 1-1/2 inches nominal density.

**END OF SECTION**

**SECTION 230719**  
**HVAC PIPING INSULATION**

**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 insulation for HVAC piping systems.
- B. Related Sections:
  - 1. Section 230713 "Duct Insulation" for duct insulation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at pipe expansion joints for each type of insulation.
  - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 4. Detail removable insulation at piping specialties.
  - 5. Detail application of field-applied jackets.
  - 6. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.



2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

#### 1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### **PART 2 - PRODUCTS**

#### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials, Type II for sheet materials.

##### 1. Manufacturers

- a. Owens-Corning
- b. Johns-Mansville
- c. Knauf
- d. Armacell
- e. Kflex
- f. Polyuard
- g. Compac
- h. Ideal
- i. Avery

- j. Venture
- k. Childers
- l. Foster
- m. ITW
- n. Vimasco
- o. Pabco
- p. GripNail
- q. Duro-Dyne
- r. Hardcast
- s. Zeston
- t. Ceelco
- u. Proto

G. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

1. Manufacturers

- a. Owens-Corning
- b. Johns-Mansville
- c. Knauf
- d. Armacell
- e. Kflex
- f. Polyuard
- g. Compac
- h. Ideal
- i. Avery
- j. Venture
- k. Childers
- l. Foster
- m. ITW
- n. Vimasco
- o. Pabco
- p. GripNail
- q. Duro-Dyne
- r. Hardcast
- s. Zeston
- t. Ceelco
- u. Proto

2. Preformed Pipe Insulation: Type I, Grade A, with factory-applied ASJ.
3. 850 deg F.
4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.2 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 800 deg F.
- C. Flexible Elastomeric Adhesive: Solvent-based adhesive.
  1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
  2. Wet Flash Point: Below 0 deg F.
  3. Service Temperature Range: 40 to 200 deg F.
  4. Color: Black.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

## 2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
  1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  2. Service Temperature Range: 0 to plus 180 deg F.
  3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
  4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  2. Service Temperature Range: 0 to plus 180 deg F.
  3. Color: White.

## 2.4 LAGGING ADHESIVES

- A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
  1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
  2. Service Temperature Range: 20 to plus 180 deg F.
  3. Color: White.

## 2.5 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
  - 1. Permanently flexible, elastomeric sealant.
    - a. Service Temperature Range: Minus 150 to plus 250 deg F.
    - b. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
  - 1. Fire- and water-resistant, flexible, elastomeric sealant.
  - 2. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 3. Color: Aluminum.
- D. ASJ Flashing Sealants:
  - 1. Fire- and water-resistant, flexible, elastomeric sealant.
  - 2. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 3. Color: White.

## 2.6 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 C1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
  - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

## 2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Metal Jacket:
  - 1. Aluminum Jacket: Comply with ASTM B209, 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: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.

- 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
- 3) Tee covers.
- 4) Flange and union covers.
- 5) End caps.
- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2. Stainless-Steel Jacket: ASTM A240/A240M.

- 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: 3-mil- thick, heat-bonded polyethylene and kraft paper.
- d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
- e. Factory-Fabricated Fitting Covers:
  - 1) Same material, finish, and thickness as jacket.
  - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
  - 3) Tee covers.
  - 4) Flange and union covers.
  - 5) End caps.
  - 6) Beveled collars.
  - 7) Valve covers.
  - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

- D. Self-Adhesive Outdoor Jacket: 60-mil- 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 with stucco-embossed aluminum-foil facing.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches
  2. Thickness: 11.5 mils
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.

6. 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 C1136.
  1. Width: 3 inches
  2. Thickness: 6.5 mils
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.

## 2.9 SECUREMENTS

- A. Bands:
  1. Stainless Steel: ASTM A240/A240M, Type 316; 0.015-inch-thick, 1/2-inch-wide with wing seal or closed seal.
  2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch-thick, 3/4-inch-wide with wing seal or closed seal.
  3. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."



### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  - 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 INSTALLATION OF MINERAL-FIBER INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.8 FIELD-APPLIED JACKET INSTALLATION

#### A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### 3.9 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

### 3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.

2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.11 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

B. Chilled Water:

1. NPS 3and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

C. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. NPS 12and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

- D. Refrigerant Suction and Hot-Gas Piping:
    - 1. All Pipe Sizes: Insulation shall be the following:
      - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - E. Refrigerant Liquid Piping:
    - 1. All Pipe Sizes: Insulation shall be the following:
      - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- 3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE
- A. Chilled Water and Brine:
    - 1. All Pipe Sizes: Insulation shall be the following:
      - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 3 inches thick.
  - B. Refrigerant Liquid Piping:
    - 1. All Pipe Sizes: Insulation shall be the following:
      - a. Flexible Elastomeric: 2 inches thick.
- 3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - B. If more than one material is listed, selection from materials listed is Contractor's option.
  - C. Piping, Concealed:
    - 1. None.
  - D. Piping, Exposed:
    - 1. Aluminum Stucco Embossed: 0.024 inch thick.
    - 2. Stainless Steel, Type 316, Stucco Embossed: 0.016 inch thick.
- 3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - B. If more than one material is listed, selection from materials listed is Contractor's option.
  - C. Piping, Concealed:
    - 1. None.
  - D. Piping, Exposed:
    - 1. Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.024 inch thick.
    - 2. Stainless Steel, Type 316 Stucco Embossed with Z-Shaped Locking Seam: 0.016 inch thick.

**END OF SECTION**

**SECTION 230900**  
**HVAC INSTRUMENTATION AND CONTROLS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, General Requirements, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls. This section includes:

- 1. Control equipment.
- 2. Software.
- 3. Sensors.
- 4. Control Instruments.
- 5. Controllers.
- 6. Wiring and conduit in connection with HVAC Instrumentation and Controls in accordance with Division 16.
- 7. Power supply to HVAC Instrumentation and Controls unless otherwise specified under Division 16.
- 8. Commissioning of HVAC Instrumentation and Controls.
- 9. Trending and coordination with other trades for Commissioning of HVAC Systems.

- B. Related Divisions include the following:

- 1. Division 22: Plumbing
- 2. Division 23: Heating, Ventilating and Air Conditioning
- 3. Division 26: Electrical

**1.3 DEFINITIONS**

- A. DDC: Direct-digital controls.
- B. LAN: Local area network.

- C. MS/TP: Master-slave/token-passing.
- D. BAS: Building Automation System
- E. BACnet: Building Automation and Control Network Protocol by ASHRAE
- F. BTL: BACnet Test Laboratory
- G. PIO: Proportional Plus Integral Plus Derivative
- H. RTD: Resistance Temperature Detection
- I. BIBBS: BACnet Interoperability Building Blocks
- J. XML: Extensible Mark-up Language
- K. OBIX: Open Building Information Exchange
- L. SOAP: Simple Object Access Protocol

#### 1.4 REFERENCES

- A. NFPA 90 – Installation of Air Conditioning and Ventilating Systems.
- B. UL 864 – Control Units for Fire Protective Signaling Systems.
- C. UL 916 – Energy Management.
- D. NFPA 91A – Recommended practice for smoke control systems.
- E. ADA – Americans with Disabilities Act.
- F. UL 508A – Manufacturer listed control panel.
- G. EIA/TIA-568 – Commercial Building Wiring Standard.
- H. ASHRAE – American Society of Heating Refrigerating and Air Conditioning Engineers
- I. ANSI/ASHRAE Standard 135-2008 BACnet
- J. EMC Directive 89/336/EEC (European CE Mark)

#### 1.5 SYSTEM DESCRIPTION

- A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- B. All systems shall extend the existing DDC system and provide seamless integration and compatibility with the existing Siemens DDC systems serving Tricity Medical Center.
- C. A distributed control system, complete with all software and hardware functions, shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2008, BACnet. This system is to control mechanical equipment specified using

native BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems shall not be acceptable and are specifically prohibited.

- D. Control system includes coordination with other trades from conception to completion of project to allow for a Commissioning and Operating HVAC Control System.
- E. Control System includes wiring and conduit in connection with HVAC Instrumentation and Controls.
- F. Control System includes the electrical power supply to HVAC Instrumentation and Controls, unless otherwise specified under Division 16. Coordinate with Electrical Contractor and other trades. Provide a complete and operational control system.

## 1.6 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
  - 1. Graphic Display Time: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
  - 2. Graphic Refresh Time: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
  - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
  - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
  - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
  - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
  - 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
  - 8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
  - 9. The requirements here are state for verification and measurement purposed and do not reduce the accuracy requirements of sensors and other components specified.
    - a. Water Temperature: Plus or minus 1°F.
    - b. Water Flow: Plus or minus 5% of full scale.
    - c. Water Pressure: Plus or minus 2% of full scale.
    - d. Dew Point Temperature: Plus or minus 3°F.
    - e. Relative Humidity: Plus or minus 5%.
    - f. Airflow (Measuring Stations): Plus or minus 5% of full scale.
    - g. Airflow (Terminal): Plus or minus 10% of full scale.
    - h. Air Pressure (Space): Plus or minus 0.01-inch wg.



- i. Air Pressure (Ducts): Plus or minus 0.1-inch wg.

## 1.7 SUBMITTALS

- A. Provide a complete and comprehensive submittal package. Partial submittals shall not be accepted. Upon completion submit all compliance data and project record documents.
- B. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
  - 1. Each control device labeled with setting or adjustable range of control.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Schematic flow diagrams showing the systems for fans, pumps, coils, dampers, valves, and control devices.
  - 2. Wiring diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring. Indicate LAN/ BACnet and or Gateway connections.
  - 3. Color scheme for control wiring.
  - 4. Details of control panel faces, including controls, instruments, and labeling.
  - 5. Written description of sequence of operation.
  - 6. Schedule of dampers including leakage and flow characteristics.
  - 7. Schedule of valves including leakage and flow characteristics.
  - 8. DDC System Architecture including number and location of controllers, computer and other hardware components.
  - 9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
  - 10. Detailed point list.
  - 11. A floor plan indicating the actual location of room temperature sensor for coordination with furniture layout.
  - 12. Program flow charting.
  - 13. A floor plan indicating location of concealed duct static pressure sensors used for controlling air moving equipment.
- D. User Interface Graphics: Provide a copy of each of the graphics developed for the Graphic User Interface including a flowchart indicating how the graphics are to be linked

to one another for system navigation. Obtain owner's approval prior to implementation. Update the graphics upon completion of the project based upon the end-user's input.

- E. Installing company qualifications.
- F. Manufacturer qualifications.
- G. Commissioning of building automation system.
- H. Installation verification of building automation system.
- I. A letter of approval signed by the project commissioning authority indicating acceptance of sequence of operation.
- J. Samples: Of each type of room temperature cover.
- K. Software and Firmware Operational Documentation: Include the following:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.
  - 5. Software license required by and installed for DDC workstations and control systems.
  - 6. Domain, Subnet, & Channel ID's.
- L. Software Upgrade Kit: For Owner to use in modifying software to suit future system revisions or monitoring and control revisions.
- M. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- N. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. Include the following:
  - 1. Maintenance instructions and lists of spare parts for each type of control device.
  - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
  - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
  - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  - 5. Calibration records and list of set points.

- O. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences. Provide an updated floor plan indication the actual installed location of room temperature sensors and duct static pressure sensors.
- P. 72-hour trend data.
- Q. HVAC Instrumentation and Controls training program.

## 1.8 QUALITY ASSURANCE

- A. Installing Company Qualifications:
  - B. Five years of experience in installation of similar systems for similar projects.
  - C. Experience in completing a minimum of three local projects of similar size with the type of DDC system specified for this project within the last five years.
  - D. A Building Automation Service Department within San Diego County with a 2-hour minimum response time for emergency service.
  - E. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems and with a record of successful in-service performance. The manufacturer's DDC control hardware and software shall have BACnet conformance approval from the BACnet Test Laboratory. The control system architecture shall consist of the components of one manufacturer regularly engaged in the production of open control systems and shall be the manufacturer's latest standard of design at the time of the bid.
  - F. Control Engineer Qualifications: A control Engineer shall oversee the design and installation of the DDC system. The Control Engineer shall have a minimum of five (5) years experience with the installing company at an equal level of responsibility. The Control Engineer shall have completed factory training for certification for the design, installation, start-up, and commissioning of the DDC components to be installed. The Control Engineer shall have experience in completing a minimum of two projects of similar size with the type of DDC system specified for this project. Removal or replacement of Control Engineer shall be subject to the owner's approval.
  - G. 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. All DDC controllers for this project shall be manufactured by single manufacturer. A mixture of DDC controllers by various manufacturers shall not be allowed. All DDC controllers, building controllers and application controllers shall communicate via BACnet LAN.
  - H. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
  - I. Comply with ASHRAE 135 for DDC system control components.
  - J. Control panels and cabinets installed in this project shall be UL 508A listed as a complete assembly. All electronic components and devices shall be enclosed in NEMA rated enclosures.

- K. All system levels shall be compliant with the BACnet Standard 135-2008. Upon completion of commissioning process and prior to acceptance, contractor shall provide a protocol analyzer and demonstrate that all system components that communicate within the system utilize the BACnet protocol. Contractor may at their expense hire a qualified, independently registered engineer to perform test. Any components that do not fully comply with the BACnet standard shall be replaced until entire system architecture is re-tested and compliant. Conflict resolution shall be submitted to BTL ([www.BACnetassociation.org](http://www.BACnetassociation.org)) at contractor's expense and BTL determination shall be final.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

## 1.10 COORDINATION

- A. Coordinate location of room temperature sensors, and other exposed control sensors with plans and room details before installation.
- B. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- C. Coordinate chiller control network requirements with chiller control requirements and control system components provided with the chiller equipment.
- D. Coordinate equipment to achieve compatibility with motor starters and annunciation devices.
- E. Coordinate with Division 16 for Electrical Power Supply to Control Equipment and Device. Unless otherwise specified under Division 16, provide and install all the electrical wiring/conduit and components for a complete and operational control system.

## 1.11 WARRANTY

- A. The system shall include all hardware and software components warranty for a period of one year following the substantial completion date. Provide a five-year warranty for all actuators.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, installing company qualifications, and manufacturer's qualifications, provide products by the following. The manufacturer shall provide DDC control hardware and software with BACnet conformance approvals from the BACnet Test Laboratory.

- 1. Electric, Electronic, and DDC Systems:
  - a. Siemens Building Technologies, BACnet Systems

## 2.2 DDC EQUIPMENT AND SOFTWARE

### A. Operator Workstation

1. Update existing operation workstation programming and graphics to reflect changes made to system and to represent all data and control devices within scope of project.

### B. Graphics software: Update existing front end graphics to reflect changes made to system within the contract. The current value and point name of every I/O point shall be shown on at least one graphic and in its appropriate physical location relative to building and mechanical systems.

### C. Web Server and Web Access

1. Update existing web server programming and access to reflect changes made to system in scope of contractor.

### D. Application-Specific DDC controllers:

1. Provide one native BACnet application specific controller for each piece of unitary mechanical equipment that adequately covers all objects listed. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.
2. Zone damper: Actuators shall be electronic with a means for lockable manual override.
3. Provide a metal NEMA 2 enclosure for actuator assembly of the zone controllers.
4. Provide a metal NEMA 2 enclosure for all electronic components of zone controller.

### E. Software Capabilities: Update to latest version of software at Project completion. Include and implement the following capabilities from the control units:

1. Units of Measure: Inch-pound and SI (metric).
2. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, DDC with fine tuning, and trend logging.
3. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
4. Programming Application Features: Include trend point, alarm messages, weekly scheduling, and interlocking.
5. Paging: Provide the means of automatic alpha numeric paging of personnel for user defined control system requirements.

## 2.3 CONTROL PANELS

- A. Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels. Provide UL 508A listed panels as a complete assembly.
1. Fabricate panels of 0.06-inch- thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
  2. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.
  3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.
  4. Graphics: Color-coded graphic, laminated-plastic displays on doors, schematically showing system being controlled, with protective, clear plastic sheet bonded to entire door.
  5. Provide one uninterrupted power supply for each main control panel.
- B. Alarm Panels: Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted in hinged-cover enclosure.
1. Alarm Condition: Indicating light flashes and horn sounds.
  2. Acknowledge Switch: Horn is silent and indicating light is steady.
  3. Second Alarm: Horn sounds and indicating light is steady.
  4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
  5. Contacts in alarm panel allow remote monitoring by independent alarm company.
- C. Provide one external Uninterrupted Power Supply (UPS) in NEMA 1 enclosure for every DDC Control Panel. Enclosures on the roof shall be NEMA 12R.

## 2.4 SENSORS AND COMMUNICATION DEVICES

- A. Electronic Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
1. Thermistor Temperature Sensors (Thermistor):
    - a. Accuracy: Plus or minus 0.5°F at calibration point.
    - b. Wire: Twisted, shielded-pair cable.
    - c. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

2. Resistance Temperature Detectors (RTD): Platinum.
  - a. Accuracy: Plus or minus 0.2% at calibration point.
  - b. Wire: Twisted, shielded-pair cable.
  - c. Insertion Elements in Ducts: Single point, 8-inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
  - d. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
  - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2-inches.
3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
  - a. Accuracy: 2% of full scale with repeatability of 0.5%.
  - b. Output: 4 to 20 mA.
  - c. Duct Static-Pressure Range: 0 to 5-inches wg.
4. Turbine Flow Insertion Tube Meters: Provide Dual Turbine Flow Insertion Tube Flow Meter with digital display of flow rate, total and 4-20 mA signal in NEMA 4X enclosure.
  - a. Accuracy:  $\pm 0.5\%$  of reading at calibrated velocity.
  - b. Output: 4 to 20 mA.
  - c. Material rated for type and temperature of fluid.
5. Liquid Pressure Transmitters: Provide Liquid Pressure Sensors with accuracy of  $\pm 1\%$  operating environment or  $-40^{\circ}\text{F}$  to  $260^{\circ}\text{F}$  with output signal of 4-20 mA.
6. Current Sensing Relays: Solid State AC switch with internal current transformer. The switch shall operate when the current level sensed by the internal current transformer exceeds the threshold value set by the adjustment knob. Provide relays with split core design for the range suitable for application. Coordinate with electrical contractor.
7. Current Transformer: Provide current transformers rated for the specified amperage. The transformer shall provide 0 to 5 VDC output signal.
8. Differential Pressure Switches: A diaphragm operated snap switch shall actuate the electrical circuit upon sensing of Differential Pressure. The setpoint range shall be 1 inch WC to 12 inch WC.
9. Electrical Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc feedback signal.

10. Humidity Sensors: Bulk polymer sensor element.
    - a. Accuracy: 1% full range.
    - b. Room Sensors: With locking cover matching room thermostats, span of 25 to 90% relative humidity.
    - c. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100% relative humidity.
  11. Pressure Transmitters: Direct acting for gas or liquid; range suitable for system; proportional output 4 to 20 mA.
  12. Duct Smoke Detectors: Comply with NFPA requirements. Coordinate with Division 16 and Fire Alarm Systems.
  13. Water Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vaporproof type. Coordinate with chiller and boiler manufacturers. Flow switches shall be approved and or provided by these manufacturers.
  14. Gateways and Direct LAN Connections: Coordinate with HVAC equipment manufacturers, provide and install a complete and operational control Gateway and or Direct LAN connection to the HVAC equipment. Coordinate with equipment manufacturers and other trades to avoid omission or duplication and assure a complete and operating system.
  15. Room Temperature Sensor: White, with concealed thermometer and override switch. Install on a sealed airtight insulated backing base.
- B. Switches and sensors applications:
1. Status Inputs for Fans: Current sensing relay.
  2. Status Inputs for Pumps: Current sensing relay.
  3. Status Inputs for other Electric Motors: Current-sensing relay.
  4. Duct Temperature Sensors: 1000 Ohm RTD Duct Sensors with operating range of 20°F to 120°F.
  5. Room Temperature Sensors: Thermistor to 55-95°F with  $\pm 0.5^\circ\text{F}$  accuracy.
  6. Chilled Water Pipe Temperature Sensors: 1000 Ohm RTD Liquid Immersion Sensors with operating range 20°F to 70°F.
  7. Hot Water Pipe Temperature Sensors: 1000 Ohm RTD Liquid Immersion Sensors with operating range of 30°F to 250°F.
  8. Provide and install all other components indicated for complete and operational system.



## 2.5 ELECTRIC THERMOSTATS

- A. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
  - 1. Equip thermostats, which control electric coiling fans directly, with off position on dial wired to break ungrounded conductors.

## 2.6 ACTUATORS

- A. Electronic Damper, Large-Valve Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
  - 1. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
  - 2. Dampers: Size for running torque calculated as follows:
    - a. Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
    - b. Pressure Drop: Dampers with 2 to 3-inches wg of Pressure Drop.
  - 3. Coupling: V-bolt and V-shaped, toothed cradle.
  - 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  - 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
  - 6. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
  - 7. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
  - 8. Temperature Rating: 40 to 104°F.
  - 9. Temperature Rating (Smoke Dampers): Minus 22 to plus 250°F.
  - 10. Run Time: 12 seconds open, 5 seconds closed.

## 2.7 CONTROL VALVES

- A. Type: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Globe Valves NPS 2 and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with back-seating capacity, repackable under pressure.
- C. Globe Valves NPS 2-1/2 and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.

- D. Hydronic system globe valves shall have the following characteristics:
1. Rating: Class 125 for service at 125 psig and 250°F operating conditions.
  2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
    - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
    - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
  3. Sizing: 3-psig maximum pressure drop at design flow rate.
  4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.
- E. Terminal Unit Control Valves: Globe valves with bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250°F operating conditions.
  2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
  3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

## 2.8 CONTROL CABLE

- A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in Division 16 Section "Control/Signal Transmission Media." Install control wiring in conduit except as specified under Part 3 of this section.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that duct, pipe, and equipment-mounted devices and wiring and piping are installed before proceeding with installation.
- C. Obtain the manufacturer data for the proposed HVAC equipment. Verify the electric power supply requirements of control interfaces and connections. Coordinate with electrical and mechanical contractors and other trades.

### 3.2 INSTALLATION

- A. Install DDC Controllers for a complete and operational system. Install all DDC controllers inside NEMA rated control panels.

- B. Install in accordance with manufacturer's instructions and full compliance of Division 16.
- C. Install control wiring and electrical work in accordance with National Electrical codes and Division 16. In addition to the requirements specified herein, the wiring installation shall meet the requirements of EIA/TIA Standard 568, Commercial Building Standard for telecommunication pathways and spaces.
- D. Wiring Inside Rigid Conduit: Outdoor exposed areas and areas exposed to weather. Minimum conduit size 3/4-inch.
- E. Plenum Rated Wiring: Concealed areas above ceilings. Coordinate with electrical contractor. Support final connection wiring in accordance to National Electric Code and at every four feet. Diagonal installation shall not be accepted. Provide sleeves for wall penetrations.
- F. Identification Standards:
  - 1. Node Identification: All nodes shall be identified by a permanent label fastened to the outside of the enclosure.
  - 2. Cable shall be labeled at a minimum of every 18-inch with the type of signal carried within the cable.
  - 3. Raceway Identification: All the covers to junction and pull boxes of the control raceways shall be painted with the appropriate color.
  - 4. Wire Identification: All low and line voltage control wiring shall be identified by a number, as referenced to the associated shop drawing and as-built drawing.
  - 5. Control wiring color coding shall be consistent throughout this project. Coordinate with the owner and other trades. Provide communication and control wiring with proper identification and labeling. Clearly label and color code control wiring as follows:
    - a. Orange: Local area network wiring.
    - b. Blue: Analog and digital, input or output points.
    - c. Green: Low voltage power wiring.
    - d. White: Line voltage wiring, or per National Electric Codes.
- G. Do not install low and line voltage wiring in the same conduit.
- H. Provide and install wiring and conduit in connection with HVAC instrumentation and controls for complete operational system.
- I. Provide and install electrical power supply to HVAC instrumentation and controls unless otherwise specified under Division 16. Coordinate with Division 16.
- J. Install transformers inside NEMA rated control enclosures.
- K. Label all control components and instruments.

- L. Verify the actual location of room temperature sensors prior to installation. Coordinate with furniture layout. Assure the location of each room temperature sensor is within the zone of the corresponding HVAC equipment. Verify that the room sensor locations provides an acceptable measurement of the controlled environment. Comply with ADA requirements.
- M. Perform and document comprehensive testing for all control installation. Provide necessary instruments and equipment to document the results.
  - 1. Verify that circuits are continuous and free from short circuits and grounds.
  - 2. Verify that circuits are free from unspecified ground. The resistance to ground of all circuits shall be over 50 megaOhms.
  - 3. Verify that circuits are free from induced voltage.
  - 4. Provide complete testing for all cables used under this contract. Provide all equipment, tools, and personnel as necessary to conduct these tests.
  - 5. Provide for complete grounding of all signal and communication cables, panels, and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
- N. Installation Quality Requirements: In addition to the requirements of Division 16, manufacturer's recommendation and National Electric Codes, provide installation quality requirements specified here for a complete and operational control system.
  - 1. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
  - 2. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
  - 3. Provide firestopping for all penetrations.
  - 4. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
  - 5. All wiring passing through penetrations, including walls, shall be in conduit or enclosed raceway.
  - 6. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
  - 7. No penetrations in structural elements shall be made before receipt of written approval from the architect.

### 3.3 COMMISSIONING OF BUILDING AUTOMATION SYSTEM

- A. Commissioning per ASHRAE Standards. Commissioning Report shall include the following:

1. 72-hour Trend Data.
  2. Installation Verification of Building Automation System.
- B. Refer to Mechanical Commissioning Section. Coordinate and provide the required expertise and services for a complete commissioning process. Coordinate with all other trades for a complete commissioned system. Coordinate with the commissioning authority.
  - C. Documents results in Standard Forms recommended by DDC manufacturer or other established organizations. Comply with the similar standards established by AABC, NEBB or ASHRAE. Obtain approval prior to commencement of the work.
  - D. Attend the monthly commissioning meeting. Coordinate with the commissioning authority of the project.
  - E. The Control Contractor's Engineer shall be present on-site for all commissioning activities involving equipment and systems controlled and monitored by the DDC system. In addition, provide no less than 45 working days for on-site support during the functional performance test.

#### 3.4 72-HOUR TREND DATA

- A. Upon completion after project provide a 72-hour data indicating complete operation of DDC System. Final acceptance of the completion of the DDC shall be based upon the 72-hour Trend Data. The Trend Data shall be in form of color Trend Graph. Provide Trend Data of all temperatures, air- and water- flow quantities, and equipment status points. This shall include room, outside air, chilled water, heating hot water, condensing water temperatures and set points. Trend data shall also include duct and pipe pressures and set points. The trend data shall also include variable frequency drive speed and frequency. It shall also include outside, return and supply air quantities and position of dampers. Provide trend data for kW meter and chiller operation. Submit specified list of points and graphic format of trending for approval prior to commencement of 72-hour trending. Coordinate with commissioning agent.
- B. Provide additional 72-hour trend data as required until full compliance.
- C. A factory-trained control technician with minimum of 3 years experience shall be physically present at the jobsite from 8:00 am to 5:00 pm during every 72-hour trending process until final acceptance.
- D. Upon completion submit the results indicating compliance in one complete package. Submit 6 sets.

#### 3.5 INSTALLATION VERIFICATION OF BUILDING AUTOMATION SYSTEM

- A. CONTROLLER VERIFICATION: Perform verification procedure on each DDC controller prior to software installation and prior to commencement of point to point check-out.
- B. Verify installation of labels and nameplates to identify control components according to Division 23.
- C. Verify installation of hydronic instrument wells, valves, and other accessories according to Division 23.

- D. Document results in Standard Forms recommended by DDC manufacturer or other established organizations. Comply with similar standards established by NEBB or ASHRAE. Obtain approval prior to commencement of the work.
- E. Upon completion submit the results indicating compliance.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
  - 3. Calibration test electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Engage a factory-authorized service representative to perform startup service.
- C. Replace damaged or malfunctioning controls and equipment.
  - 1. Start, test, and adjust control systems.
  - 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
  - 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- D. Verify DDC as follows:
  - 1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
  - 2. Verify operation of operator workstation.
  - 3. Verify local control units including self-diagnostics.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
  - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  - 2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices,

resetting default values, and requesting logs. In addition to training requirements specified elsewhere, include a minimum of 15 hours' dedicated factory instructor time on-site.

3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
5. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION





## SECTION 230993.11

### SEQUENCE OF OPERATIONS FOR HVAC DDC

#### 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 control sequences for DDC for HVAC systems, subsystems, and equipment.

##### 1.3 DEFINITIONS

- A. Analog Output: Proportional output signal (zero- to 10-V dc, 4 to 20 mA).
- B. Binary Output: On/off output signal or contact closure.
- C. DDC: Direct digital control.
- D. Digital Output: Data output that must be interpreted digitally.

##### 1.4 ACTION SUBMITTALS

- A. Product Data:
  - 1. An instrumentation list for each controlled system. Label each element of the controlled system in table format. Show, in the table element name, type of device, manufacturer, model number, and control device product data sheet number.
  - 2. A complete description of the operation of the control system, including sequences of operation. Include and reference a schematic diagram of the controlled system.
- B. Shop Drawings:
  - 1. Riser diagrams showing control network layout, communication protocol, and wire types.
  - 2. Schematic diagram of each controlled system. Include all control points labeled with point names shown or listed. Show the location of control elements in the system.
  - 3. Wiring diagram for each controlled system. Show all control elements labels. Where a control element is the same as that shown on the control system schematic, label with the same name. Label all terminals.

##### 1.5 TERMINAL UNIT OPERATING SEQUENCE

- A. Heating Coils, Hydronic:
  - 1. Space Temperature:
    - a. Input:
      - 1) Device: Air-temperature sensor
      - 2) Location: Space.
      - 3) Transference: DDC controller.
    - b. Output:
      - 1) Device: Analog output.
      - 2) Location: Control valve.
      - 3) Transference: Valve actuator.
    - c. Action: Modulate valve to maintain the following space temperature set points:

- 1) Occupied Heating Temperature: 75 deg F.
- 2) Unoccupied Heating Temperature: 70 deg F.

B. Indicate the following on the operator's workstation display terminal:

1. DDC system graphic.
2. DDC system on-off indication (operating or not operating).
3. DDC system occupied/unoccupied mode.
4. Heating Coils, Hydronic:
  - a. Space temperature indication.
  - b. Space temperature set point.

1.6 Exhaust Fan (General Exhaust)

- A. Provide DDC control using electric actuation for start/stop monitoring and interlock
- B. The exhaust fan shall be interlocked to run with its corresponding air handling unit and shall run continuously.
- C. Safety:
  1. The DDC system shall use a current sensing relay to monitor the fan status.

1.7 Exhaust Fan (MRI Emergency Exhaust)

- A. The exhaust fan shall have a manual exhaust fan switch near the Operator Workspace and in the Magnet room near the door. Switches shall be connected in parallel.
- B. Safety:
  1. The DDC system shall use a current sensing relay to monitor the fan status.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION**

**SECTION 23 21 13  
HYDRONIC PIPING**

**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. Copper tube and fittings.
  - 2. Steel pipe and fittings.
  - 3. Joining materials.
  - 4. Transition fittings.
  - 5. Dielectric fittings.
  - 6. Bypass chemical feeder.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Pipe and tube.
  - 2. Fittings.
  - 3. Joining materials.
  - 4. Transition fittings.
  - 5. Bypass chemical feeder.
- B. Delegated-Design Submittal:
  - 1. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
  - 2. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Preconstruction Test Reports:
  - 1. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

**PART 2 - PRODUCTS**

2.1 GENERAL REQUIREMENTS

- A. Manufacturers:
  - 1. U.S. Steel Corporation
  - 2. Wheatland Tube
  - 3. Kelly Pipe Co.
  - 4. Bonney Forge
  - 5. Weldbend

6. Ladish
7. Anvil
8. Mueller Industries
9. Cerro Flow Products
10. Elkhart Products
11. NIBCO

## 2.2 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
  1. Hot-Water Heating Piping: 125 psig at 200 deg F.
  2. Chilled-Water Piping: 125 psig at 73 deg F.
  3. Condenser-Water Piping: 125 psig at 73 deg F.
  4. Makeup-Water Piping: 80 psig at 73 deg F.
  5. Condensate-Drain Piping: 150 deg F.

## 2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type L (ASTM B88M, Type B)
- B. Annealed-Temper Copper Tube: ASTM B88, Type L (ASTM B88M, Type B)
- C. DWV Copper Tube: ASTM B306, Type DWV.
- D. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- E. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- F. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- G. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- H. Wrought Copper Unions: ASME B16.22.

## 2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  1. Material Group: 1.1.
  2. End Connections: Butt welding.
  3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A733, made of same materials and wall thicknesses as pipe in which they are installed.

## 2.5 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

- E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- 2.6 DIELECTRIC FITTINGS
- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
  - B. Dielectric Unions:
    - 1. Description:
      - a. Standard: ASSE 1079.
      - b. Pressure Rating: **150 psig**.
      - c. End Connections: Solder-joint copper alloy and threaded ferrous.
  - C. Dielectric Flanges:
    - 1. Description:
      - a. Standard: ASSE 1079.
      - b. Factory-fabricated, bolted, companion-flange assembly.
      - c. Pressure Rating: **150 psig**.
      - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
  - D. Dielectric-Flange Insulating Kits:
    - 1. Description:
      - a. Nonconducting materials for field assembly of companion flanges.
      - b. Pressure Rating: **150 psig**.
      - c. Gasket: Neoprene or phenolic.
      - d. Bolt Sleeves: Phenolic or polyethylene.
      - e. Washers: Phenolic with steel backing washers.
  - E. Dielectric Nipples:
    - 1. Description:
      - a. Standard: IAPMO PS 66.
      - b. Electroplated steel nipple, complying with ASTM F1545.
      - c. Pressure Rating: **300 psig at 225 deg F**.
      - d. End Connections: Male threaded.
      - e. Lining: Inert and noncorrosive, propylene.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground be the following:
  - 1. **Type L**, drawn-temper copper tubing, wrought-copper fittings, and **soldered** or **brazed** joints.
  - 2. joints. Use the fewest possible joints.
- B. Chilled-water piping, aboveground shall be the following:
  - 1. **Type L**, drawn-temper copper tubing, wrought-copper fittings, and **soldered** or **brazed** joints.
- C. Condensate-Drain Piping, Copper: **Type M**, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

#### 3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.

- H. Install fittings for changes in direction and branch connections.
  - I. Install piping to allow application of insulation.
  - J. Select system components with pressure rating equal to or greater than system operating pressure.
  - K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
  - L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
  - M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
  - N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
  - O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
  - P. Install valves according to the following:
    1. Section 230523.12 "Ball Valves for HVAC Piping."
    2. Section 230523.14 "Check Valves for HVAC Piping."
  - Q. Install unions in piping, **NPS 2** and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
  - R. Install flanges in piping, **NPS 2-1/2** and larger, at final connections of equipment and elsewhere as indicated.
  - S. Install shutoff valve immediately upstream of each dielectric fitting.
  - T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
  - U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
  - V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
  - W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
  - X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."
- 3.3 JOINT CONSTRUCTION
- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  - B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - C. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
  - D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
  - E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
  - F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- 3.4 INSTALLATION OF DIELECTRIC FITTINGS
- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  - B. Dielectric Fittings for **NPS 2** and Smaller: Use dielectric **nipples**.
  - C. Dielectric Fittings for **NPS 2-1/2 to NPS 4**: Use dielectric **flanges**.
  - D. Dielectric Fittings for **NPS 5** and Larger: Use dielectric flange kits.

- 3.5 INSTALLATION OF HANGERS AND SUPPORTS
- A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  - B. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
  - C. Install hangers for **copper tubing** with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
  - D. Support horizontal piping within **12 inches** of each fitting and coupling.
  - E. Support vertical runs of [**copper tubing**] [**and**] [**steel piping**] to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- 3.6 TERMINAL EQUIPMENT CONNECTIONS
- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
  - B. Install control valves in accessible locations close to connected equipment.
  - C. Install ports for pressure gauges and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."
- 3.7 IDENTIFICATION
- A. Identify system components. Comply with requirements for identification materials and installation in Section 230553 "Identification for HVAC Piping and Equipment."
- 3.8 FIELD QUALITY CONTROL
- A. Prepare hydronic piping according to ASME B31.9 and as follows:
    1. Leave joints, including welds, uninsulated and exposed for examination during test.
    2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
    3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
    4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
    5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
  - B. Perform the following tests on hydronic piping:
    1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
    2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
    3. Isolate expansion tanks and determine that hydronic system is full of water.
    4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
    5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
    6. Prepare written report of testing.
  - C. Perform the following before operating the system:
    1. Open manual valves fully.
    2. Inspect pumps for proper rotation.
    3. Set makeup pressure-reducing valves for required system pressure.
    4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
    5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113



**SECTION 23 21 16**  
**HYDRONIC PIPING SPECIALTIES**

**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. Hydronic specialty valves.
- 2. Air-control devices.
- 3. Strainers.
- 4. Connectors.

B. Related Requirements:

- 1. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for expansion fittings and loops.
- 2. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
- 3. Section 230523.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.
- 4. Section 230523.15 "Gate Valves for HVAC Piping" for specification and installation requirements for gate valves common to most piping systems.
- 5. Section 230923.11 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product:

- 1. Include construction details and material descriptions for hydronic piping specialties.
- 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- 3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For hydronic piping specialties to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Safety Valves and Pressure Vessels: Shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

**PART 2 - PRODUCTS**

2.1 AIR-CONTROL DEVICES

A. Manual Air Vents:

- 1. Body: Bronze.
- 2. Internal Parts: Nonferrous.
- 3. Operator: Screwdriver or thumbscrew.
- 4. Inlet Connection: NPS 1/2.
- 5. Discharge Connection: NPS 1/8.
- 6. CWP Rating: 150 psig.
- 7. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

## 2.2 STRAINERS

### A. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20
4. -mesh strainer, or perforated stainless-steel basket.
5. CWP Rating: 125 psig.

## **PART 3 - EXECUTION**

### 3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

### 3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

**END OF SECTION 232116**

**SECTION 23 31 13**  
**METAL DUCTS**

**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. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 DEFINITIONS

- A. OSHPD: Office of Statewide Health Planning and Development (State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For sealants, indicating VOC content.
4. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For antimicrobial coatings, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of **all** duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
  2. Joint and seam construction and sealing.
  3. Reinforcement details and spacing.
  4. Materials, fabrication, assembly, and spacing of hangers and supports.
  5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
  - B. Welding certificates.
  - C. Field quality-control reports.
- 1.6 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
    1. AWS D1.1, "Structural Welding Code - Steel," for hangers and supports.
    2. AWS D1.2, "Structural Welding Code - Aluminum," for aluminum supports.
    3. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

## **PART 2 - PRODUCTS**

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
- C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

### 2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  2. Construct ducts within MRI shielding of aluminum.
  3. For ducts exposed to weather, construct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  1. For ducts with longest side less than **36 inches**, select joint types in accordance with Figure 2-1.
  2. For ducts with longest side **36 inches** or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
  3. {Where specified for specific applications, all joints shall be welded.}
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-

support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.

1. {Where specified for specific applications, all joints shall be welded.}

- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.

2. Construct ducts within MRI shielding of aluminum.

3. For ducts exposed to weather, construct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

- C. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

- D. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "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's "HVAC Duct Construction Standards - Metal and Flexible."

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 in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.4 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.

1. Galvanized Coating Designation: G90 (Z275).

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90 (Z275).

2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.

3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

- D. Carbon-Steel Sheets: Comply with ASTM A1008, with oiled, matte finish for exposed ducts.

- E. Stainless-Steel Sheets: Comply with ASTM A480, Type 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
  - F. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
  - G. 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 in accordance with ASTM D3363.
    - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
    - 5. Shop-Applied Coating Color: White.
    - 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
  - H. Reinforcement Shapes and Plates: ASTM A36, steel plates, shapes, and bars; black and galvanized.
    - 1. 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.
  - I. Tie Rods: Galvanized steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.
- 2.5 SEALANT AND GASKETS
- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  - B. Two-Part Tape Sealing System:
    - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
    - 2. Tape Width: 4 inches.
    - 3. Sealant: Modified styrene acrylic.
    - 4. Water resistant.
    - 5. Mold and mildew resistant.
    - 6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
    - 7. Service: Indoor and outdoor.
    - 8. Service Temperature: Minus 40 to plus 200 deg F.
    - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
    - 10. Sealant shall have a VOC content of 420 g/L or less.
    - 11. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  - C. Water-Based Joint and Seam Sealant:
    - 1. Application Method: Brush on.
    - 2. Solids Content: Minimum 65 percent.
    - 3. Shore A Hardness: Minimum 20.
    - 4. Water resistant.
    - 5. Mold and mildew resistant.
    - 6. VOC: Maximum 75 g/L (less water).
    - 7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
    - 8. Service: Indoor or outdoor.
    - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- D. Flanged Joint Sealant: Comply with ASTM C920.
    - 1. General: Single-component, acid-curing, silicone, elastomeric.
    - 2. Type: S.
    - 3. Grade: NS.
    - 4. Class: 25.
    - 5. Use: O.
    - 6. Sealant shall have a VOC content of 420 g/L or less.
    - 7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  - E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
  - F. Round Duct Joint O-Ring Seals:
    - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
    - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
    - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.
- 2.6 HANGERS AND SUPPORTS
- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
  - B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  - C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
  - D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
  - E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
  - F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
  - G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
  - H. Trapeze and Riser Supports:
    - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
    - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
    - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
- 2.7 SEISMIC-RESTRAINT DEVICES
- A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by OSHPD, in State of California an agency acceptable to authorities having jurisdiction.
  - B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
  - C. Restraint Cables: ASTM A492, stainless-steel cables with end connections made of galvanized-steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
  - D. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
  - E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested in accordance with ASTM E488.

### **PART 3 - EXECUTION**

#### **3.1 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
  - C. Install ducts in maximum practical lengths with fewest possible joints.
  - D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
  - E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
  - F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
  - G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
  - H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
  - I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
  - J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
  - K. Install heating coils, , air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
  - L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
  - M. Elbows: Use long-radius elbows wherever they fit.
    1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
    2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
  - N. Branch Connections: Use lateral or conical branch connections.
- 3.2 DUCT SEALING
- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
    1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
    3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
    4. Unconditioned Space, Exhaust Ducts: Seal Class C.
    5. Unconditioned Space, Return-Air Ducts: Seal Class B.
    6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
    7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
    8. Conditioned Space, Exhaust Ducts: Seal Class B.
    9. Conditioned Space, Return-Air Ducts: Seal Class C.
- 3.3 HANGER AND SUPPORT INSTALLATION
- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
  - B. Building Attachments: Concrete inserts, powder-actuated fasteners (only where specifically allowed by the project Structural Engineer), or structural-steel fasteners appropriate for construction materials to which hangers are being attached.



1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- 3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION
- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.
1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by OSHPD
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed 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. Set anchors to manufacturer's recommended torque, using a torque wrench.
  5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.
- 3.5 CONNECTIONS
- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.
- 3.6 PAINTING
- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099123 "Interior Painting."
- 3.7 FIELD QUALITY CONTROL
- A. Perform tests and inspections.

- B. Leakage Tests:
1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
    - b. Supply Ducts with a Pressure Class of 4- Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - c. Return Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - d. Exhaust Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - e. Outdoor-Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
  3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
  5. Test for leaks before applying external insulation.
  6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  7. Give **seven** days' advance notice for testing.
- C. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present.
  2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
1. instructions after removal of surface deposits and debris.
- 3.8 STARTUP
- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
- 3.9 DUCT SCHEDULE
- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Ducts within MRI shield shall be non-ferrous:
1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- C. Supply Ducts:
1. Ducts Connected to Constant-Volume Air-Handling Units:
    - a. Pressure Class: Positive **4** inch wg.
    - b. SMACNA Leakage Class for Rectangular: **4**.
    - c. SMACNA Leakage Class for Round and Flat Oval: **2**.
- D. Return Ducts:
1. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative **2--** inch wg.
    - b. SMACNA Leakage Class for Rectangular: **8**.

- c. SMACNA Leakage Class for Round and Flat Oval: **16**.
- E. Exhaust Ducts:
  - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative **2**-inch wg.
    - b. SMACNA Leakage Class for Rectangular: **8**.
    - c. SMACNA Leakage Class for Round and Flat Oval. **16**.
  - 2. Ducts Connected to MRI Equipment:
    - a. Material
      - 1) SS 304: minimum .035 wall thickness
      - 2) AL 6061-T6 minimum .083 wall thickness
    - b. Welded Seams
    - c. Corrugated pip or spiral duct must not be used
    - d. Duct shall withstand a maximum pressure of 35 psi
- F. Elbow Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      - 2) Mitered Type RE 4 without vanes.
    - b. Velocity 1000 to 1500 fpm:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
    - c. Velocity 1500 fpm or Higher:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
    - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      - 4) Radius-to Diameter Ratio: 1.5.
    - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- G. Branch Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

- a. Rectangular Main to Rectangular Branch: 45-degree entry.
- b. Rectangular Main to Round Branch: Conical spin in.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm: Conical tap.
  - c. Velocity 1500 fpm or Higher: 45-degree lateral.

**END OF SECTION 233113**

**SECTION 233300**  
**AIR DUCT ACCESSORIES**

**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. Manual volume dampers.
2. Fire dampers.
3. Combination fire and smoke dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Duct accessory hardware.

B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
3. Section 284621.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

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

- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
  - a. Special fittings.
  - b. Manual volume damper installations.
  - c. Control-damper installations.
  - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
  - e. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 90A and NFPA 90B.
- B. 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.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturer
    - a. Air Balance
    - b. Ruskin
    - c. Greenheck
    - d. Ductmate
    - e. TDC
    - f. Ward Industries
    - g. Duro-Dyne
    - h. Young Regulator
  - 2. Performance:
    - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
  - 3. Construction:
    - a. Linkage out of airstream.
    - b. Suitable for horizontal or vertical airflow applications.
  - 4. Frames:
    - a. Hat-shaped, 16-gauge-thick, galvanized sheet steel.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized steel; 16 gauge thick.
  - 6. Blade Axles: Galvanized steel.

7. Bearings:
    - a. Molded synthetic.
    - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
  8. Tie Bars and Brackets: Galvanized steel.
  9. Locking device to hold damper blades in a fixed position without vibration.
- B. Standard, Aluminum, Manual Volume Dampers:
1. Performance:
    - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
  2. Construction:
    - a. Linkage out of airstream.
    - b. Suitable for horizontal or vertical airflow applications.
  3. Frames:
    - a. Hat-shaped, 0.10-inch- thick, aluminum sheet channels.
    - b. Flanges for attaching to walls and flangeless frames for installing in ducts.
  4. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
    - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
  5. Blade Axles: Nonferrous metal.
  6. Bearings:
    - a. Molded synthetic.
    - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
  7. Tie Bars and Brackets: Aluminum.
  8. Locking device to hold damper blades in a fixed position without vibration.
- C. Low-Leakage, Steel, Manual Volume Dampers:
1. Performance:
    - a. AMCA Certification: Test and rate in accordance with AMCA 511.
    - b. Leakage:
      - 1) Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
  2. Construction:
    - a. Linkage: Out of airstream.
    - b. Suitable for horizontal or vertical airflow applications.
  3. Frames:
    - a. Hat, U, or angle shaped.

- b. Thickness: 16-gauge galvanized sheet steel.
  - c. Mitered and welded corners.
  - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
- a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized, roll-formed steel; 16 gauge thick.
5. Blade Edging Seals:
- a. Closed-cell neoprene.
  - b. Inflatable seal blade edging or replaceable rubber seals.
6. Blade Jamb Seals: Neoprene.
7. Blade Axles: Galvanized steel.
8. Bearings:
- a. Molded synthetic.
  - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
9. Tie Bars and Brackets: Galvanized steel.
10. Locking device to hold damper blades in a fixed position without vibration.
- D. Low-Leakage, Aluminum, Manual Volume Dampers:
1. Performance:
- a. AMCA Certification: Test and rate in accordance with AMCA 511.
  - b. Leakage:
    - 1) Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
2. Construction:
- a. Linkage out of airstream.
  - b. Suitable for horizontal or vertical airflow applications.
3. Frames:
- a. Hat, U, or angle shaped.
  - b. Thickness: 0.08-inch aluminum sheet channels.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
- a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Roll-Formed Aluminum Blades: 0.072-inch thick aluminum sheet.
  - d. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
5. Blade Edging Seals:
- a. Closed-cell neoprene.
  - b. Inflatable seal blade edging or replaceable rubber seals.



6. Blade Jamb Seals: Neoprene.
7. Blade Axles: Nonferrous metal.
8. Bearings:
  - a. Molded synthetic.
  - b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.
9. Tie Bars and Brackets: Aluminum.
10. Locking device to hold damper blades in a fixed position without vibration.

E. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

## 2.3 FIRE DAMPERS

A. Manufacturer

1. Air Balance
2. Aire Technologies
3. Arrow United Industries
4. Cesco Products
5. CL Ward & Family
6. Greenheck Fan Corporation
7. NCA Manufacturing Inc
8. Pottorff
9. Prefco
10. Ruskin Company
11. Safe Air – Dowco Products
12. United Enertech
13. Vent Products Co

B. Type: dynamic; rated and labeled in accordance with UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.

- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed galvanized sheet steel. Material gauge is to be in accordance with UL listing.
- I. Horizontal Dampers: Include blade lock and stainless steel closure spring.
- J. Heat-Responsive Device:
  - 1. Replaceable, 165 deg Frated, fusible links.

## 2.4 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturer
  - 1. Air Balance
  - 2. Aire Technologies
  - 3. Arrow United Industries
  - 4. Cesco Products
  - 5. CL Ward & Family
  - 6. Greenheck Fan Corporation
  - 7. NCA Manufacturing Inc
  - 8. Pottorff
  - 9. Ruskin Company
  - 10. Safe Air – Dowco Producs
  - 11. United Enertech
- B. General Requirements:
  - 1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
  - 2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
  - 3. Unless otherwise indicated, use parallel-blade configuration.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Performance:
  - 1. AMCA Certification: Test and rate in accordance with AMCE Publication 511.
  - 2. Leakage:
    - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
  - 3. Pressure Drop: 0.05 in. wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
  - 4. Velocity: Up to 3000 fpm.
  - 5. Temperature: Minus 25 to plus 180 deg F.
  - 6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
- F. Construction:
  - 1. Suitable or horizontal or vertical airflow applications.
  - 2. Linkage out of airstream.
  - 3. Frame:

- a. Hat shaped.
  - b. Galvanized sheet steel, with welded corners and mounting flange.
  - c. Gauge is to be in accordance with UL listing.
4. Blades:
- a. Roll-formed, horizontal, v-groove, galvanized sheet steel.
  - b. Maximum width and gauge in accordance with UL listing.
5. Blade Edging Seals:
- a. Silicone rubber.
6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of airstream.
8. Bearings:
- a. Stainless steel sleeve.
- G. Mounting Sleeve:
- 1. Factory installed, galvanized sheet steel.
  - 2. Length to suit wall or floor application with factory-furnished silicone caulking.
  - 3. Gauge in accordance with UL listing.
- H. Heat-Responsive Device:
- 1. Resettable, 165 deg F rated, fire-closure device.
  - 2. Electric resettable device and switch package, factory installed, rated.
- I. Master control panel for use in dynamic smoke-management systems.
- J. Damper Actuator - Electric:
- 1. Electric - 120 V ac.
  - 2. UL 873, plenum rated.
  - 3. Designed to operate in smoke-control systems complying with UL 555S requirements.
  - 4. Two position with fail-safe spring return.
    - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
    - b. Maximum 15-second full-stroke closure.
    - c. Minimum 90-degree drive rotation.
  - 5. Clockwise or counterclockwise drive rotation as required for application.
  - 6. Environmental Operating Range:
    - a. Temperature: Minus 40 to plus 130 deg F.
    - b. Humidity: 5 to 95 percent relative humidity noncondensing.
  - 7. Environmental Enclosure: NEMA 2.
  - 8. Actuator to be factory mounted and provided with single-point wiring connection.
- K. Controllers, Electrical Devices, and Wiring:
- 1. Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
  - 2. Electrical Connection: 115 V, single phase, 60 Hz.

- L. Accessories:
  - 1. Auxiliary switches for position indication.
  - 2. Test and reset switches, remote mounted.
  - 3. Smoke Detector: Integral, factory wired for single-point connection.

## 2.5 FLANGE CONNECTORS

- A. Manufacturer
  - 1. CL Ward & Family
  - 2. Ductmate Industries
  - 3. DynAir
  - 4. Elgen Manufacturing
  - 5. Ward Industries
- B. Description: roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gauge and Shape: Match connecting ductwork.

## 2.6 TURNING VANES

- A. Manufactured Acoustic Turning Vanes for Metal Doors: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill; support with bars perpendicular to blades set; set into valve runners suitable for duct mounting.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- C. Vane Construction:
  - 1. Double wall.

## 2.7 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."
  - 1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. 24-gauge- thick galvanized steel door panel.
    - d. Vision panel.
    - e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - f. Fabricate doors airtight and suitable for duct pressure class.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
    - a. 24-gauge- thick galvanized steel or 0.032-inch- thick aluminum frame.
  - 3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Continuous and two sash locks.

- c. Access Doors up to 24 by 48 Inches: Three hinges Continuous and two compression latches with outside and inside handles.
- d. Access Doors Larger Than 24 by 48 Inches: [Four hinges] [Continuous] and two compression latches with outside and inside handles.

## 2.8 FLEXIBLE CONNECTORS

- A. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Materials: Flame-retardant or noncombustible fabrics.
- D. Coatings and Adhesives: Comply with UL 181, Class 1.
- E. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd.
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## 2.9 MATERIALS

- A. MRI Room: All duct accessories within the shielding of the MRI Room shall be non-ferrous.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.

- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
  - 1. All duct accessories within the shielding of the MRI Room shall be non-ferrous.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install fire and smoke dampers in accordance with UL listing.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Downstream from control dampers and equipment.
  - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 4. Control devices requiring inspection.
  - 5. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.

- 6. Body plus Ladder Access: 25 by 17 inches.
  - L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
  - M. Install flexible connectors to connect ducts to equipment.
  - N. Install duct test holes where required for testing and balancing purposes.
- 3.2 FIELD QUALITY CONTROL
- A. Tests and Inspections:
    - 1. Operate dampers to verify full range of movement.
    - 2. Inspect locations of access doors and verify that size and location of access doors are adequate to perform required operation.
    - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
    - 4. Inspect turning vanes for proper and secure installation and verify that vanes do not move or rattle.
    - 5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION**





**SECTION 233346**  
**FLEXIBLE DUCTS**

**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. Non-insulated flexible ducts.
  - 2. Insulated flexible ducts.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For flexible ducts.
  - 1. Include plans showing locations and mounting and attachment details.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

**PART 2 - PRODUCTS**

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. 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.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E96, "Test Methods for Water Vapor Transmission of Materials."

2.2 NON-INSULATED FLEXIBLE DUCTS

- A. Manufacturer
  - 1. Flexmaster USA Inc
  - 2. JP Lamborn Co
  - 3. McGill Airflow
  - 4. Thermaflex
  - 5. Ward Industries
- B. Non-Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.

3. Temperature Range: Minus 10 to plus 160 deg F.

## 2.3 INSULATED FLEXIBLE DUCTS

- A. Manufacturer
  1. Flexmaster USA
  2. JP Lamborn Co
  3. McGill AirFlow
  4. Thermaflex
  5. Ward Industries
- B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
  1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  2. Maximum Air Velocity: 4000 fpm.
  3. Temperature Range: Minus 10 to plus 160 deg F.
  4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

## 2.4 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches, to suit duct size.
- B. Non-Clamp Connectors: Adhesive, Liquid adhesive plus tape, or Adhesive plus sheet metal screws.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect terminal units to supply ducts directly.
- D. Connect diffusers to ducts with a minimum of 36-inch and maximum 60-inch lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with draw bands.
- F. Install duct test holes where required for testing and balancing purposes.
- G. Installation:
  1. Install ducts fully extended.
  2. Do not bend ducts across sharp corners.
  3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
  4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  5. Install flexible ducts in a direct line, without sags, twists, or turns.
- H. Supporting Flexible Ducts:
  1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.

2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 60 inches o.c.

**END OF SECTION**



**SECTION 233423**  
**HVAC POWER VENTILATORS**

**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. Centrifugal ventilators - roof upblast.

1.3 ACTION SUBMITTALS

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

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Prefabricated roof curbs.
9. Fan speed controllers.

- B. Shop Drawings:

1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include diagrams for power, signal, and control wiring.
3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints.

- C. Delegated-Design Submittal: For unit hangars and supports 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 requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

- B. Seismic Qualification Data: For fans, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
- 1.5 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and maintenance manuals.

## **PART 2 - PRODUCTS**

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation and seismic restraints, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: HVAC power ventilators shall be have OSPHD special seismic certification preapproval (OSP)

### 2.2 CENTRIFUGAL VENTILATORS - ROOF UPBLAST OR SIDEWALL

- A. Manufacturer
1. Greenheck Fan Corporation
- B. Configuration: Centrifugal roof upblast ventilator.
- C. Housing: Removable spun-aluminum dome top and outlet baffle; square, one-piece aluminum base with venturi inlet cone.
1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades
- E. Accessories:
1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted fan housing, factory wired through an internal aluminum conduit.
  3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
  4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
  6. Spark-resistant, all-aluminum wheel construction.
  7. Mounting Pedestal: Galvanized steel with removable access panel.
  8. Wall Mount Adapter: Attach wall-mounted fan to wall.
- F. Prefabricated Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange Manufactured to accommodate roof slope.

## 2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## 2.4 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.
- C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.
- D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.
- E. Operating Limits: Classify according to AMCA 99.
- F. UL Standards: Power ventilators shall comply with UL 705

## **PART 3 - EXECUTION**

### 3.1 INSTALLATION OF HVAC POWER VENTILATORS

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
  1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
  2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- C. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

### 3.2 DUCTWORK CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

### 3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to 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 tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Verify that there is adequate maintenance and access space.
  - 4. Verify that cleaning and adjusting are complete.
  - 5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 6. Adjust damper linkages for proper damper operation.
  - 7. Verify lubrication for bearings and other moving parts.
  - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  - 10. Shut unit down and reconnect automatic temperature-control operators.
  - 11. Remove and replace malfunctioning units and retest as specified above.
- E. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- C. Lubricate bearings.

### 3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.



**END OF SECTION**



## SECTION 233713.13

### AIR DIFFUSERS

#### 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. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. MRI diffusers.

###### B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

##### 1.3 ACTION SUBMITTALS

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

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

##### 1.4 INFORMATIONAL SUBMITTALS

###### A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

###### B. Source quality-control reports.

#### PART 2 - PRODUCTS

##### 2.1 PERFORATED DIFFUSERS

###### A. Manufacturer:

1. Krueger
2. Price Industries
3. Titus

###### B. Material: Aluminum pattern.

- C. Finish: Baked enamel, white
- D. Face Style: Flush.
- E. Mounting: Surface or T-bar per ceiling design.
- F. Pattern Controller: Four louvered deflector patches.
- G. Accessories:
  - 1. Adjustable damper.
  - 2. Plaster ring (as required).

2.2 PERFORATED DIFFUSERS (MRI Room)

- A. Manufacturer:
  - 1. Krueger
  - 2. Price Industries
  - 3. Titus
- B. Material: Aluminum. MRI compatible
- C. Finish: Baked enamel, white
- D. Face Style: Plaque
- E. Mounting: Surface or T-bar per ceiling design.
- F. Accessories: Adjustable damper.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION**

**SECTION 233713.23**  
**REGISTERS AND GRILLES**

**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. Adjustable blade face registers and grilles.
- 2. Fixed face registers and grilles.

B. Related Requirements:

- 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
- 2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
- 2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

- 1. Ceiling suspension assembly members.
- 2. Method of attaching hangers to building structure.
- 3. Size and location of initial access modules for acoustical tile.
- 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- 5. Duct access panels.

**PART 2 - PRODUCTS**

2.1 REGISTERS

A. Fixed Face Register:

- 1. Manufacturer
  - a. Krueger
  - b. Price Industries
  - c. Titus
- 2. Material: Aluminum
- 3. Finish: Baked enamel, white

4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.

## 2.2 GRILLES

- A. Adjustable Blade Face Grille:
- B. Fixed Face Grille:
  1. Manufacturer
    - a. Krueger
    - b. Price Industries
    - c. Titus
  2. Material: Aluminum
  3. Finish: Baked enamel, white
  4. Face Blade Arrangement: Horizontal; spaced 3/4 inch apart.
  5. Face Arrangement: Perforated core.
- C. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION**

**SECTION 23 81 26**  
**SPLIT SYSTEM AIR CONDITIONERS**

**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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- 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. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-Up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: One year(s) from date of Substantial Completion.
    - b. For Parts: One year(s) from date of Substantial Completion.
    - c. For Labor: One year(s) from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set(s) for each air-handling unit.
  - 2. Gaskets: One set(s) for each access door.

3. Fan Belts: One set(s) for each air-handling unit fan.

## **PART 2 - PRODUCTS**

- A. Manufacturers
  1. Mitsubishi Mr. Slim cooling only or equal.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounted, compressor-condenser components on 4-inch- thick, reinforced concrete base that is 4 inches larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- D. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
- E. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- F. Install seismic restraints.
- G. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch see Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- H. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts" Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

### **3.4 STARTUP SERVICE**

- A. Perform startup service.
  1. Complete installation and startup checks according to manufacturer's written instructions.
  2. Provide written startup report on both equipment and refrigerant piping tests.

## **END OF SECTION**



**SECTION 238216.11**  
**HYDRONIC AIR COILS**

**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. Hydronic air coils.

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 each air coil.
  - 2. Include rated capacities, operating characteristics, and pressure drops for each air coil.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, sections, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. ASHRAE 62.1 Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5, "Systems and Equipment," and Section 7, "Construction and Startup."
- B. Performance Ratings: Tested and rated in accordance with AHRI 410 and ASHRAE 33.
- C. Minimum Working-Pressure/Temperature Ratings: 200 psig/220 deg F.
- D. Hot-Water Coil Capacities and Characteristics:
  - 1. See drawings

2.2 HYDRONIC AIR COILS

- A. Manufacturer
  - 1. Trane
- B. Description: Coil designed with aluminum or copper plate fins and copper/copper alloy tubes. Collar drawn fins, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. Coil airflow and nameplate attached to coil casing.
- C. Tubes: Two row, single serpentine coil, with 5/8" OD tubes.
- D. Coil Casing: Galvanized Steel
- E. Coil Plate Fin Type: Aluminum Plate fin

2.3 SOURCE QUALITY CONTROL

- A. Hydronic Coils: Factory tested with air while coil is completely submerged underwater to design pressure indicated, but not less than 300-psig internal pressure.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed in accordance with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.
- D. Straighten bent fins on air coils.
- E. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

#### **3.3 PIPING CONNECTIONS**

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section 230923 "Control Specification," and other piping specialties are specified in Section 232116 "Hydronic Piping Specialties."

**END OF SECTION**

## SECTION 238413.29

### SELF-CONTAINED STEAM HUMIDIFIERS

#### 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. Self-contained electrode humidifiers.
  - 2. Condensate drain coolers.

##### 1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail fabrication and installation of humidifiers. Include piping details, plans, elevations, sections, details of components, distributor tubes/manifolds, and attachments to other work.
  - 1. Include diagrams for power, signal, and control wiring.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail humidifiers and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members to which humidifiers will be attached.
  - 2. Size and location of initial access modules for ceilings.
- B. Seismic Qualification Data: Certificates, for humidifiers, accessories, and components from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Field quality-control reports.

##### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For humidifiers to include in operation and maintenance manuals.

##### 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.

## 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Supply one replacement electrode cylinder with each self-contained humidifier.

## 1.9 COORDINATION

- A. Coordinate location and installation of humidifiers with distributor tubes/manifolds in ducts or occupied space. Verify locations and elevations to suit field conditions and to ensure proper humidifier operation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE 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. Comply with AHRI 640.
- C. Comply with UL 998.
- D. Listed and labeled by C-UL US.
- E. Seismic Performance: Self-contained steam humidifiers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- F. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.

### 2.2 SELF-CONTAINED ELECTRODE HUMIDIFIERS

- A. Manufacturer: Nortec.
- B. Provide Nortec Model EL electrode humidifier generating mineral-free, sterile steam from a potable water supply Packaged unit, wall mounted, atmospheric steam generation using an electrode steam cylinder(s).

Units to be complete with:

- a) Touchscreen controller with standard building automation:
  - i. Intuitive touchscreen control with color graphic user interface.
  - ii. Standard building automation communication protocols BACnet IP, BACnet MSTP and Modbus. Additional hardware required for building automation communication not acceptable.
  - iii. Embedded web interface for easy configuration and remote monitoring from any computer with a web browser over a local area network (LAN) connection.
  - iv. USB interface for new software/feature upload and download of operational information.
  - v. Single or dual channel analog signal acceptance, supporting both demand and transducer control. Ability to control setpoint from humidifier control when using transducer controls.
- b) Packaged system with Condair electrode cylinder technology:

- i. Condair cylinder optimized for humidifier capacity and supply voltage. Cylinder must have welded seam to ensure watertight and have high water sensor to prevent overfilling.
- ii. Durable powder coated steel cabinet with zero side clearance requirement for minimal footprint.
- iii. Insulating air gap between plumbing and electrical compartment for increased electronic reliability.
- iv. Standard internal drain water tempering to ensure maximum 140° F drain water. External drain water cooler not acceptable.
- v. Integral fill cup with minimum 1-inch air gap to prevent back siphoning.
- vi. Full cylinder indication and pre-notification of automatic shutdown at end of cylinder life.
- vii. Automatic pulse feature to clean any obstruction from the drain solenoid valve if required.
- viii. Automatic off-season shut-down after 3 days of "no call" will completely drain the cylinder(s) and automatically restart on call for humidity. Adjustable on/off and time sequence. Provides extended cylinder life, while ensuring stagnant water does not remain in the system.

c) Condair Auto-Adaptive Control water management:

- i. Advanced water management utilizing the patented Proportional plus Integral Auto- Adaptive Control system for optimal energy efficiency, water usage and cylinder life.
- ii. 98% thermal efficiency from startup until end of cylinder life.
- iii. Drains automatically optimized to water conditions to maximize cylinder and reduce water usage.
- iv. Modulating output between 25% and 100% of rated capacity.

C. Accessories:

- 1. Humidity Sensor: Return-duct mounted.
- 2. Duct-mounted, high-limit humidistat.
- 3. Airflow switch prevents humidifier operation without airflow.
- 4. Steam and Condensate Hoses: For interconnection of humidifier to distributor tube(s)/manifold.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine ducts and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install humidifiers with required clearance for service and maintenance. Maintain path, downstream from humidifiers, clear of obstructions as required by ASHRAE 62.1.

- B. Seal all duct and plenum penetrations with flange.
- C. Install humidifier assemblies in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- D. Install stainless-steel drain pan under each manifold mounted in duct.
  - 1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1.
  - 2. Connect to condensate trap and drainage piping.
  - 3. Extend drain pan upstream and downstream from tube(s)/manifold a minimum distance recommended by manufacturer but not less than required by ASHRAE 62.1.
- E. Install tube(s)/manifold supply piping pitched to drain condensate back to humidifier or as recommended by manufacturer.
- F. Equipment Mounting:
  - 1. Install humidifiers per manufacturer's instructions.
  - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- G. Install all manufacturer-furnished accessories in accordance with manufacturer's written installation instructions.

### 3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
  - 1. Install piping adjacent to humidifiers to allow service and maintenance.
  - 2. Install shutoff valve, strainer, backflow preventer, and union in humidifier makeup line.
- B. Install piping specialties furnished by manufacturer but not factory mounted.
- C. Install piping from safety relief valves to nearest floor drain.

### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between control devices.
- C. Connect control wiring according to Section 260523 "Control Voltage Electrical Power Cables."

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to 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:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Humidifier will be considered defective if it does not pass tests and inspections.
  - E. Prepare test and inspection reports.
- 3.7 DEMONSTRATION
- A. Train Owner's maintenance personnel to adjust, operate, and maintain humidifiers.

**END OF SECTION**





**Section 26 05 00**  
**GENERAL ELECTRICAL REQUIREMENTS**

**PART 1 – GENERAL**

1.1 SUMMARY

- A. This Section includes the general requirements for Division 26 - Electrical.
  - 1. Division 1 and the General Conditions apply to all work of this section.
  - 2. Division 26 supplements the applicable requirements of other Divisions.
- B. The Work includes all labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this division, complete, as shown on the drawings and/or specified herein.
  - 1. Examine all divisions for related work required to be included as work under this division.
- C. Owner-furnished items: Pick up Owner-furnished items and handle, deliver, install, and make all final connections.
  - 1. Assume responsibility for the items when consigned at the storage facility in accord with requirements of the Contract Documents.

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.
- B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:
  - 1. ANSI American National Standards Institute
  - 2. ASTM American Society for Testing and Materials
  - 3. IEEE Institute of Electrical and Electronics Engineers
  - 4. CECCalifornia Electrical Code (NFPA 70)
  - 5. NEMA National Electrical Manufacturers Association
  - 6. NFPA National Fire Protection Association
  - 7. UL Underwriters Laboratories, Inc.

1.3 QUALITY ASSURANCE

- A. Regulation: All the electrical equipment and materials, including their installation, shall conform to the following latest applicable codes and standards:
  - 1. California Electrical Code (CEC).

2. California State Fire Marshal.
  3. Occupational Safety and Health Act (OSHA).
  4. Requirements of Serving Utility Companies.
  5. Local Codes and Ordinances.
  6. Requirements of the California Division of the State (DSA).
  7. California Administrative Code, Title 8, Chapter 4, Industrial Safety Orders.
  8. California Administrative Code, Title 24.
  9. Variances: In instances where two or more codes are at variance, the most restrictive requirement shall apply.
- B. Contractor's Expense: Obtain and pay for all required bonds, insurance, licenses, and pay for all taxes, fees and utility charges required for the electrical work.

#### 1.4 SUBMITTALS

- A. Submit all of the items described in Paragraphs 1, 2, and 3 (below) as a single submittal. Partial submittals will not be accepted. Contractor shall review submittals for conformance with Contract Documents and make necessary revisions. Contractor shall also verify dimensions of equipment and be satisfied as to fit and that they comply with all code requirements relating to adequacy and clear working space. Submit the following in accordance with Division 1, with the additional electrical systems-related document requirements and additional number of copy sets as specified below:

1. Contractor shall submit shop drawings sealed by a Structural Engineer registered in the State of California to demonstrate compliance with the following requirement:

Confirm that electrical equipment has been seismically-braced and anchored to resist a horizontal force (including a simultaneous vertical force of one-third the horizontal values shown) acting in any direction using the following criteria:

Fixed equipment on grade:	33% of operating weight.
Fixed equipment on structure:	33% of operating weight.
Emergency power equipment* on grade:	50% of operating weight.
Emergency power equipment* on structure:	75% of operating weight.

\*Note: Also applicable to communications equipment.

For flexibly-mounted equipment, use twice the above values.

2. Product data/material lists (also see applicable technical specification sections following for additional requirements), at least six submittal document sets, for:
  - a. Raceways
  - b. Building wire and cable
  - c. Cabinets, boxes and fittings
  - d. Wiring devices
  - e. Grounding components
  - f. Supporting devices
  - g. Nameplates and identification markers/labels
  - h. Overcurrent protective devices

### 3. Substitutions

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

- a. All substitutions must be submitted in writing to the Owner. Contractor shall submit to the Owner a typewritten list containing a description of each proposed substitute material or equipment.
- b. The Owner will accept, in writing, proposed substitutions that are, in the Owner's opinion, equal in quality, utility and appearance to the material or equipment specified. Such acceptance shall not relieve Contractor from complying with the requirements of the Drawings and the Specifications.
- c. Contractor shall be responsible for all costs of any changes resulting from Contractor's proposed substitutions which affect other parts of the Work or the work of separate Contractors.
  - 1) Contractor also agrees to compensate the Owner for time and expenses spent reviewing substitutions.
- d. The decision of the Owner shall be final.

### 4. Instruction Materials (also see applicable technical specification sections following for additional requirements), six submittal document sets, for:

- a. Provide prior to the time of the personnel instruction period, instruction manuals associated with all systems listed above.
- b. Include the following information, as a minimum, in each copy of the instruction manual:
  - 1) Manufacturers' names and addresses.
  - 2) Serial numbers of items furnished.
  - 3) Catalog cuts, exploded views and brochures, complete with technical and performance data for all equipment, marked to indicate actual items furnished and the intended use.
  - 4) Recommended maintenance procedures.

#### B. Project record documents:

1. Mark Record Documents daily to indicate all changes made in the field.
  - a. In addition to general requirements of Record Documents, indicate on Project Record Drawings all changes of equipment locations and ratings, fuse sizes, trip sizes and settings on magnetic-only circuit breakers.
  - b. Alterations in raceway runs and sizes, changes in wire sizes, circuit designations, installation details, one line diagrams, control diagrams and schedules.
2. Use green to indicate deletions and red to indicate additions.
  - a. Use the same symbols and follow as much as possible the same drafting procedures used on the Contract Drawings.

## 1.5 OPERATING AND MAINTENANCE MANUALS

- A. Prepare and submit Operating and Maintenance Manuals, six document sets. In addition to the requirements specified in Division 1 (also see technical specification sections following for additional requirements), include the following information for equipment items:
  - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers and replacement parts.
  - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and, as required, summer and winter operating instructions.
  - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  - 4. Servicing instructions and lubrication charts and schedules.

#### 1.6 QUALITY ASSURANCE

- A. As a minimum Specification requirement, all materials and methods shall comply with applicable governing codes.
- B. Material and equipment substitution.
  - 1. Equipment other than that specified will be accepted only when written approval is given by the Owner, in accordance with Division 1.
  - 2. The Contractor shall be held responsible for all physical changes in piping, equipment, etc. resulting from equipment substitution and likewise bear any increased cost of other trades in making said substitution. Approval by the Owner of equipment other than that specified does not relieve the Contractor of this responsibility.

#### 1.7 OWNER'S INSTRUCTIONS

- A. Prior to completion of the contract, and at the Owner's convenience, instruct verbally and demonstrate to the Owner's personnel, the operation of the systems as listed in Part 1 above.

#### 1.8 SYSTEM STARTUP

- A. Do not energize or place electrical equipment in service until all relevant parties have been duly notified and are present or have waived their rights to be present. Where equipment to be placed in service involves service or connection from another contractor of the Owner, notify the Owner in writing when the equipment will be ready. Notify the Owner's Representative two weeks in advance of the date the various times of equipment will be complete.

### **PART 2 - PRODUCTS Not Used**

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Site verification of conditions: Contractor shall survey the entire project site and become thoroughly familiar with actual existing conditions. The intent of the work is shown on the drawings and described hereinafter. By the act of participation in the pre-bid conference and site inspection tour specified in the applicable Division 1 section, the Contractor shall be deemed to have made such a study and examination and to accept all conditions present at the site. No request for additional payment shall be considered as valid, due to failure to allow

for conditions which may exist.

- B. Electrical work shown: Electrical drawings are generally diagrammatic. Verify equipment sizes with shop drawings and manufacturers' data and coordinate location layout with other trades. Report immediately to the Owner any conflicts in the drawings and specifications with any code or between the electrical work and the work of other trades. No work shall be commenced where a conflict exists prior to receiving proper instructions. Any work or materials shown on the drawings and not mentioned in this division, or vice-versa, shall be executed the same as if specifically mentioned by both. Notify the Owner of any changes of location requirements prior to installation.

### 3.2 SEISMIC BRACING

- A. Contractor shall be responsible for anchors and connections of electrical work to building structure to prevent damage as a result of earthquake, including manufactured equipment, the connection and integrity of shop-fabricated and field-fabricated materials and equipment. All building equipment and connections therefore shall be designed to resist seismic forces in conformance with Title 24 of the California Administrative Code.

Contractor shall submit shop drawings sealed by a Structural Engineer registered in the State of California to demonstrate compliance with the following requirements:

1. Electrical equipment: For requirements, see Part 1 above.
2. Raceway: All raceway shall be supported and braced per SMACNA □ Guidelines for Seismic Restraint Systems and Plumbing Piping Systems. □ (See Table 23-P of Title 24 for limitations.)

### 3.3 PENETRATION SEALING

- A. Seal penetrations through exterior walls and fire rated walls, floors, and ceilings. Sealing methods used shall be in compliance with the requirements of the Authority Having Jurisdiction to maintain required fire ratings, and shall be in accordance with the applicable sections in Division 7 which prescribe applicable firestopping and weatherproofing of wall, floor, ceiling, and roof penetrations. Seal all conduit penetrations through roofs.

### 3.4 DEMOLITION, ALTERATION AND EXTENSION WORK

- A. Provide and perform demolition, alteration, extension, preparatory and miscellaneous work as indicated.
- B. Existing Conditions: Make a detailed survey of the existing conditions pertaining to the work. Check the locations of all existing structures equipment, wiring, etc. include all demolition, alteration and extension work in bid.

### 3.5 SERVICE INTERRUPTIONS AND UTILITY

- A. Coordinate with the Owner any interruption of services necessary to accomplish the work.
- B. Coordinate with the utility company all work associated with power and communications/signal distribution systems and service entrance equipment.

### 3.6 FIELD QUALITY CONTROL

- A. Site Tests:
  1. Perform all necessary tests required to ascertain that the electrical system has been

properly installed, that the power supply to each item of equipment is correct, and that the system is free of grounds, ground faults, and open circuits, that all motors are rotating in the proper directions, and such other tests and adjustments as may be required for the proper completion and operation of the electrical system.

2. Test the input and output voltage of each transformer prior to operation under load, and adjust the output voltage by resetting taps, to achieve the specified values. After the system has been placed under load, test transformers under normal operation. Record the measurement of primary and secondary voltages. Reset taps to within 1/2% if necessary to adjust secondary voltage. Submit a report indicating the final result of such tests, and reporting specific current and voltage measurements to the Owner's Representative.
3. If, during the course of testing, it is found that system imbalance is in excess of 20%, rearrange single-pole branch circuits in lighting and receptacle panels to bring system balance within 20% on all phases. Record all such changes on the panelboard schedule and submit a summary of changes to the Owner's Representative.

### 3.7 CLEANING

- A. Clean exterior surfaces of equipment and remove all dirt, cement, plaster and other debris. Protect interior of equipment from dirt during construction and clean thoroughly before energizing.
- B. Clean-out cracks, corners and surfaces on equipment to be painted, remove grease and oil spots so that paint may be applied without further preparation.
- C. Locate underground conduit stubbed-out for future use, underground feeder conduits, and feeder pull box locations, using building lines by indicating on the Project Record Drawings.

**END OF SECTION**







**SECTION 26 05 19**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes wire and cable systems rated 600 volts and less:
  - 1. Building wire and cable.
  - 2. Wiring connectors and connection accessories.
- B. Cabling requirements in this Section may be supplemented in other sections of these specifications.
- C. Related Sections:
  - 1. General electrical requirements: Section 260500.
  - 2. Wiring devices: Section 262726.
  - 3. Grounding and bonding: Section 260526.
  - 4. Supporting devices: Section 260529.
  - 5. Electrical identification: Section 260553.

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.
- B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:
  - 1. ANSI American National Standards Institute
  - 2. ASTM American Society for Testing and Materials.
  - 3. IEEE Institute of Electrical and Electronics Engineers.  
  
IEEE Standard 82 Test Procedures for Impulse Voltage Tests on Insulated Conductors.
  - 4. CECCalifornia Electrical Code (NFPA 70).
  - 5. NECA National Electrical Contractors Association: "Standard of Installation".
  - 6. National Electrical Manufacturers Association/Insulated Cable Engineers Association  
  
NEMA/ICEA WC-5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

- NEMA/ICEA WC-7 Cross-Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- NEMA/ICEA WC-8 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

7. NFPA National Fire Protection Association

8. Underwriters Laboratories, Inc.

- UL 62 Flexible Cord and Fixture Wire.
- UL 486A Wire Connectors and Wiring Lugs for Use with Copper Conductors
- UL 486B Wire Connectors for Use with Aluminum Conductors
- UL 83 Thermoplastic-Insulated Wires and Cables.
- UL 854 Service Entrance Cables.

### 1.3 SUBMITTALS

- A. General: Submit the following in accordance with the Conditions of the Contract and Division 1 Specification Sections, and Section 260500, "Common Work Results for Electrical".
- B. Samples: Provide samples upon specific request.
- C. Product Data: Submit product data giving complete description for sizes employed, material types, and electrical ratings.
- D. Certificates:
  - 1. Labels of Underwriters' Laboratories, Inc., fixed to each item of material.
  - 2. If materials are by manufacturers other than those specified submit certification that material meets applicable Underwriters' Laboratories, Inc. Standards.
  - 3. Submit in accordance with Section 260500.

### 1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with CEC, "California Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the

General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260000, "General Electrical Requirements."

- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.
- C. Deliver wire and cable to the project in full unbroken cartons or reels marked with conductor size, insulation type, and Underwriters' Laboratories, Inc. label.
- D. Handle wire and cable in a manner to prevent damage to conductor, insulation and identifying markings.

#### 1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of wiring system prior to rough-in.
- C. Wire and cable routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

Subject to compliance with requirements, provide products by the following, or equal:

- A. Wire and cable:

Triangle  
Anaconda  
General Cable Corporation

- B. Connectors:

AMP  
Burdny  
3M Company  
Thomas & Betts

- C. Insulating Tapes: 3M Company

- D. Wire Ties:

Ideal  
Thomas and Betts ("Ty-Rap")  
Panduit

- E. Pulling Compound: Ideal ("Yellow 77").

#### 2.2 MATERIALS

- A. General: Provide wire and cable suitable for the temperature, conditions, and location where installed, except as otherwise indicated.

1. Conductor: Copper. Provide solid conductor for No. 10 AWG and smaller. Provide stranded conductors for sizes No. 8 and larger.
    - a. Use stranded conductors:
      - 1) At motors and other applications where subject to vibration.
      - 2) For control circuits.
  2. Minimum Size Conductor: No. 12 AWG, except as otherwise indicated.
    - a. Control circuits: No. 14 AWG.
  3. Insulation voltage rating: 600 volts.
- B. Building wire and cable:
1. Description: Single conductor insulated wire.
  2. Insulation: ANSI/NFPA 70:
    - a. Type THHN/THWN, rated 75 degrees C.
    - b. Type XHHW, rated 90 degrees C.
- C. Flexible cord and cable: ANSI/NFPA 70. Type SO.
- D. Connectors:
1. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.
- E. Pull Cord: 1/8" polypropylene or nylon.

### **PART 3 - EXECUTION**

#### **3.1 WIRING METHOD**

A. General:

1. Use insulation types suitable for the temperature, moisture and elements to which exposed.
  - a. Minimum 75°C temperature rated insulation on conductors, except as otherwise indicated.
    - 1) Use minimum 90°C temperature rated insulation on conductors in conduits exposed on roof, or where required due to ambient temperature.
2. Equipment grounding conductors:
  - a. Provide where required by the California Electrical Code, and where indicated. Where conductor size is not indicated, provide size as required by the California Electrical Code.
  - b. Provide for:

- 1) All branch circuit wiring.
  - 2) All feeders and motor branch circuits
  - 3) All nonmetallic conduits.
  - 4) All flexible metal conduits exceeding 72 inches in length.
3. Use flexible cords and cables for connection of special equipment as indicated. Length not to exceed 72 inches.
- B. Wire and cable connections:
1. Connector types:
    - a. No. 10 AWG wire and smaller: Spring-type connectors. All terminations shall be made on device terminals or on terminal blocks.
      - 1) Maximum number of conductors in a connection: 3.
    - b. No. 8 AWG wire and larger: Compression- or pressure-type solderless connectors and terminal lugs. Wrap connection with electrical insulating tape, half-lapped to produce a dielectric value equal to or greater than wire insulation.
  2. Provide connector sealing packs for splices that require complete protection from dampness and water where indicated.
  3. Splices in feeders and mains may only be made where designated on the drawings and where prior approval is obtained from Owner.
  4. Location of splices and terminations shall be limited to accessible locations such as outlet boxes, pull boxes, junction boxes, panelboard boxes, and splice boxes.
  5. Insulate taps and splices equal to insulation of adjoining conductor.
  6. Splice or tap permitted only on conductors that are a component part of a single circuit properly protected by approved methods.

### 3.2 PREPARATION

- A. Examine the system in which the wire is to be installed for defects in equipment and installation which may cause damage to the wire.
- B. Examine wires to be jointed, tapped, spliced, terminated, and their connecting devices for defects which may affect the mechanical and electrical integrity of the connection.
- C. Check conduit systems for damage and loose connections, replace damaged sections. Make sure that the inside of conduit is free of dirt and moisture.
  1. Completely and thoroughly swab raceway before installing wire.
  2. Pull mandrel, one size smaller than the conduit, through entire length of all underground conduits prior to conductor installation.
- D. Do not start work until defects have been corrected and until authorization to proceed has been obtained from Owner's Representative.

### 3.3 INSTALLATION

- A. Install wire, cable, and connectors in compliance with the CEC.
- B. Install products in accordance with manufacturers instructions.
- C. Install all wire in raceway.
- D. When pulling conductors do not exceed manufacturer's recommended values.
- E. Use polypropylene or nylon ropes for pulling conductors.
- F. Do not bend wire less than the manufacturer's recommended minimum bending radius.
- G. Coordinate cable installation with other work.
- H. Protect exposed cable from damage.
- I. Support cables above accessible ceiling, using spring metal clips or cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
- J. Use suitable cable fittings and connectors..
- K. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound where necessary.
- L. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.
- M. Conceal all cable in finished spaces.
- N. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.
- O. Keep conductor splices to a minimum.
- P. Clean conductor surfaces before installing connectors.
- Q. Tape uninsulated conductors and connectors with electrical insulating tape to 150 percent of insulation rating of conductor.
- R. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.
- S. Use splice and tap connectors which are compatible with conductor material.
- T. Provide adequate length of conductors within electrical enclosures and neatly train the conductors to terminal points with no excess. Make terminations so there is no bare conductor at the terminal.
- U. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

- V. Circuits of multiple phases passing through enclosures shall have phases grouped (bundled together) to reduce the reactance effect.
- W. Arrange conductors in switchboards, panelboards, gutters, boxes, control cabinets and terminal cabinets neatly and lace with black T & B "Ty-Raps" ties.
- X. Connect control circuits as indicated and in accordance with the wiring diagrams furnished by the equipment manufacturer. Control conductors shall be color coded or identified with the provision of non-deteriorating type wire markers.
- Y. Consistently color code wiring continuous throughout the work:
  1. Color code secondary service, feeder, and branch circuit conductors with insulation/jacket (factory-applied) color for phase identification as follows:

<u>Phase</u>	-- System Voltage --	
	<u>208Y/120</u>	<u>480Y/277</u>
A	Black	Brown
B	Red	Orange
C	Blue Yellow	
Neutral	White	White
Ground	Green	Green

2. Select consistent wiring color code for switch legs, travelers, and special systems.
3. For conductors No. 6 AWG or larger, permanent plastic colored tape may be used to mark conductor in lieu of color-coded insulation/jacket. Tape shall cover not less than 2 inches of conductor insulation within enclosures.

### 3.4 IDENTIFICATION

- A. In addition to requirements in Section 16195, the following are applicable:
  1. At all switchboard terminations, provide each feeder circuit with a permanent plastic name tag indicating the load fed.
  2. Feeders: Identify with the corresponding circuit designation at over-current device and load ends, at all splices and in pull boxes.
  3. Branch Circuits: Identify with the corresponding circuit designation at the over-current device and at all splices and devices.
  4. Control Wires: Identify with the indicated number and/or letter designation at all terminal points and connections.
  5. Alarm and Detection Wires: Identify with the indicated wire and zone numbers at all connection, terminal points, and coiled conductors within cabinets.
  6. Conductors Terminated by Others: Indicate location of opposite end of conductor, i.e., Pull Box-Room 101.
  7. For identification of conductors use plastic coated self-sticking markers such as Thomas & Betts E-Z Code.

8. Circuit Designation is construed to mean panel designation and circuit number, i.e., LA-13.

### 3.5 FIELD QUALITY CONTROL

#### A. Prior to energizing:

1. Inspect wire and cable for physical damage and proper connection.
  - a. Confirm that field-connections made by others in equipment furnished by others are mechanically and electrically sound prior to energization.
2. Confirm electrical continuity and absence of short circuits for all wire and cable with the use of a megohm meter.
  - a. Obtain values for phase-to-phase, phase-to-neutral, and phase-to-ground.
3. Confirm required insulation resistance as follows:
  - a. Perform insulation resistance test for all 600 volt insulated conductors No. 8 AWG and larger.
  - b. Use a 500 volt megger.
  - c. Obtain and record values for insulation resistance to ground and for insulation resistance between each conductor and every other conductor in the same conduit.
  - d. Conductors not complying with the following minimum values of insulation resistance are to be replaced and retested until satisfactory.

Conductor Rated Amperes:	Minimum Insulation Resistance, Ohms:
31 through 50	500,000
51 through 100	250,000
101 through 200	100,000
201 through 400	50,000

- e. Perform tests after conductors have been installed, but before terminal connections have been made. Take readings for each test after the voltage has been applied continuously for one minute.
- f. Perform tests according to manufacturer's recommendations.
- g. Test results shall be in accordance with manufacturer's recommendations.
- h. Correct defects revealed by above tests.

#### B. Subsequent to wire and cable hook-ups:

1. Energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

END OF SECTION



**SECTION 26 05 26**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

A. This Section includes basic materials and methods for grounding and bonding electrical systems and equipment. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1. Equipment grounding conductors.
2. Bonding.

B. System Requirements

1. Electrical continuity to ground metal raceways and enclosures which are isolated from the equipment ground due to use of conduit or fittings which are nonmetallic (non-conducting), shall be established by providing by a green insulated grounding conductor of approved size within each raceway which shall connect to the isolated metallic raceways or enclosures at supply side. (If bare grounding conductors were specified, connect to enclosure on raceway at both ends.)
2. Cold water or other utility piping systems alone not be used as grounding electrodes due to the use of insulating couplings and nonmetallic pipe in such installation. All grounding electrodes shall be "Made Electrodes" as specified herein.
3. Non-current-carrying metal parts of all high voltage, conduit systems, supports, cabinets and enclosures shall be permanently and effectively grounded.
4. Metallic or semi-conducting shields and lead sheaths of all cables operating at high voltage shall be permanently and effectively grounded at each splice and termination.

C. Related Sections

1. General electrical requirements: Section 26 05 00.
2. Wire and cable: Section 26 05 19.
3. Wiring devices: Section 26 27 26.
4. Supporting devices: Section 26 05 29.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. American National Standards Institute.  
  
ANSI C2 National Electrical Safety Code.

2. American Society for Testing and Materials.

ASTM B3 Soft or Annealed Copper Wire.

ASTM 33 Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes.

ASTM B8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

3. Institute of Electrical and Electronics Engineers.

IEEE 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

4. Lightning Protection Code (NFPA 78).

5. CEC California Electrical Code (CEC).

6. NEMA National Electrical Manufacturers Association.

7. NFPA National Fire Protection Association

8. Underwriters Laboratories, Inc.

UL 467 Electrical Grounding and Bonding Equipment.

UL 486A Wire Connectors and Grounding Lugs for Use With Copper Conductors.

UL 96 Lightning Protection Components.

### 1.3 SUBMITTALS

A. In addition to this Section, the submittal requirements of Section 260500 are applicable.

B. Product Data: Provide data for grounding electrodes and connections.

C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

D. Operating, Maintenance, and Instructional Data: Manufacturers' written operating, maintenance, and installation instructions, including directions for storage and protection, handling, examination, and preparation. Include specific instructions for preparation and installation of exothermic connectors.

1. In addition, include copies of this data in Operating and Maintenance Manuals submitted, see Section 260500.

### 1.4 QUALITY ASSURANCE

A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.

B. Electrical Component Standard: Components and installation shall comply with CEC, "California Electrical Code."

C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards for grounding and bonding materials and systems. Provide products and components listed and labeled by UL.

D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."

E. Source Quality Control: Quality control testing shall meet applicable Underwriters'

Laboratories Inc. Standards.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 16010, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

#### 1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

#### 1.7 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of grounding electrodes.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by the following, or equal:

Burndy  
Erico Products (CADWELD)  
Kearney-National  
O-Z/Gedney  
Thomas & Betts

#### 2.2 GROUNDING AND BONDING PRODUCTS

- A. Products: Of types indicated and of sizes and ratings to comply with CEC. Where types, sizes, ratings, and quantities indicated are in excess of CEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- B. Conductor Materials: Copper.

#### 2.3 WIRE AND CABLE CONDUCTORS

- A. General: Comply with the following, except as otherwise indicated:
- B. Equipment Grounding Conductor: Green insulated copper.
- C. Grounding Electrode Conductor: Stranded copper cable.
- D. Bare Copper Conductors: Conform to the following:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Assembly of Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.

#### 2.4 MISCELLANEOUS CONDUCTORS

- A. Ground Bus: Bare annealed copper bars of rectangular cross section, minimum 1/4 inch x 3

inch x 12 inch drilled and tapped every 2 inches on center for two hole lugs.

- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gauge bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

## 2.5 CONNECTOR PRODUCTS

- A. General: Listed and labeled as grounding connectors for the materials used.
- B. Pressure Connectors: High-conductivity plated units.
- C. Bolted Clamps: Heavy-duty units listed for the application.
- D. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Equipment Grounding Conductor Application:

Comply with CEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

1. Install separate insulated equipment grounding conductors with circuit conductors for the following in addition to those locations where required by Code:
  - a. Feeders and branch circuits.

- B. Flexible metal and liquid-tight conduit: Provide equipment grounding conductors.
- C. Rigid nonmetallic conduit: Provide equipment grounding conductors

### 3.2 CONNECTIONS

- A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible. Make connections with clean bare metal at points of contact.
- B. Exothermic Welded Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Do not alter molds. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare copper grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare copper grounding conductors.
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in

accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

- E. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
- F. Moisture Protection: Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

### 3.3 FIELD QUALITY CONTROL

- A. Test all ground fault interrupter (GFI) receptacles and circuit breakers for proper connection and operation with methods and instruments prescribed by the manufacturer.
- B. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells. Measure ground resistance without the soil being moistened by any other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the two-point method in accordance with Section 9.03 of IEEE 81.
- C. Ground/resistance maximum values shall be as follows:
  - 1. Equipment rated 500 kVA and less: 10 Ohms.
  - 2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms.
  - 3. Equipment rated over 1000 kVA: 3 Ohms.
  - 4. Unfenced substations and pad-mounted equipment: 5 Ohms.
  - 5. Manhole and handhole grounds: 10 Ohms.
  - 6. Grounded secondary distribution system neutral and non-current carrying parts associated with distribution systems and grounds not otherwise covered: 25 ohms.
- D. Deficiencies: Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values. Where measures are directed that exceed those indicated, the provisions of the Contract covering the changes shall apply.
- E. Report: Prepare test reports, certified by the testing organization, of the ground resistance and device function tests at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
  - 1. Provide copies of reports of all grounding system tests for inclusion in Operation and Maintenance Manuals and for review by the Owner.

**END OF SECTION**



**SECTION 26 05 29**  
**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

A. This Section Includes:

1. Hangers, straps, clamps, steel channel, and fastening hardware for supporting and anchoring electrical work.

B. Related Sections:

1. General electrical requirements: Section 260500.
2. Wire and cable: Section 260519.
3. Grounding and bonding: Section 260526.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. ANSI American National Standards Institute
2. ASTM American Society for Testing and Materials
3. IEEE Institute of Electrical and Electronics Engineers
4. CECCalifornia Electrical Code (CEC)
5. NEMA National Electrical Manufacturers Association
6. NFPA National Fire Protection Association
7. UL Underwriters Laboratories, Inc.
8. NECA National Electrical Contractors Association ("Standard of Installation")

1.3 SUBMITTALS

A. In addition to this Section, the submittal requirements of Section 260500 are applicable.

B. Product Data: Provide manufacturer's catalog data for supporting devices and fastening systems.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instruction for storage, handling, protection, examination, preparation, installation, and starting of Product.

#### 1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70, "California Electrical Code."
- B. Furnish products listed and classified by Underwriter's Laboratories, Inc. as suitable for purpose specified and shown.

#### 1.5 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with CEC, "California Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500.
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

#### 1.7 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.
- B. Verify supporting device requirements prior to rough-in.
- C. Electrical work is shown on Drawings in approximate locations unless dimensioned. Provide supporting devices as required to complete the electrical work.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by the following, or equal:

- 1. Hangers, Straps and Beam Clamps:

Appleton  
Raco, Inc.  
Steel City  
O.Z./Gedney Co.  
Midland Ross



2. U-Channel Systems, Slotted Metal Angle, and Fittings:

B-Line  
Unistrut

3. Anchors:

Acherman-Johnson Corp.  
B-Line  
Hilti  
Phillips Drill Co.  
Rawl Products Co.

4. Conduit Sealing Bushings: O-Z/Gedney.

2.2 MATERIAL AND FABRICATION

A. Coatings: Supports, support hardware, and fasteners shall be protected with zinc coating. Products for use outdoors shall be hot-dip galvanized.

B. Manufactured supporting devices:

1. Raceway supports: Steel. Clevis hangers, riser clamps, pipe straps, threaded C-clamps with retainers, ceiling trapeze hangers, and wall brackets.

2. U-Channel systems: 12-gauge steel channels, with 9/16 inch diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

3. Fasteners: Types, materials, and construction features as follows:

- a. Expansion anchors: Carbon steel wedge or sleeve type.
- b. Toggle bolts: All-steel springhead type.
- c. Powder-driven threaded studs: Heat-treated steel, designed specifically for the intended service.

4. Concrete Inserts: Steel, with hot-dipped galvanized finish.

5. Cable support for vertical conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

6. Conduit sealing bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

C. Fabricated supporting devices:

1. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

2. Steel brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

3. Pipe sleeves: Provide pipe sleeves of the following:
  - a. Sheet metal: Fabricate from galvanized sheet metal: round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gauge metal for sleeve diameter noted:  
  
3-inch and smaller: 20-gauge.  
4-inch to 6-inch: 16-gauge.  
Over 6-inch: 14-gauge.
  - b. Steel pipe: Fabricate from Schedule 40 galvanized steel pipe.
  - c. Plastic pipe: Fabricate from Schedule 80 PVC plastic pipe.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Provide supporting devices to fasten electrical components securely and permanently to the building or structure in accordance with CEC requirements. Install products in accordance with manufacturer's instructions.
- B. Coordinate with the building structural, mechanical, and other systems, and with other electrical installation.
- C. Fastening: Fasten electrical items and their supporting hardware securely to the building structure. Electrical items include, but are not limited to: raceway, cables, cable tray, busway, transformers, panelboards, enclosed switches and motor controllers, control components, boxes, and cabinets.
  1. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.
  2. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams, or to a depth of more than 3/4 inch in concrete shall not cut reinforcing bars. Fill holes that are not used.
  3. Fastening methods:
    - a. Wood: Wood screws.
    - b. Hollow masonry units: Lag/Anchor bolts.
    - c. Concrete or solid masonry: Concrete inserts or expansion bolts. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts.
    - d. Steel: Machine screws or welded steel studs.
- D. Conductors in vertical raceways: Provide support for wire and cable in riser pull boxes in accordance with CEC Article 300.
- E. Sleeves: Provide in concrete slabs and walls and all other fire-rated floors and walls for raceway and cable installations. For sleeves through fire-rated wall- or floor-construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables. Comply with the requirements of fire-resistant joint sealers in accordance the applicable Division 7 section.
  1. Conduit seals: Install conduit seals for conduit penetrations of slabs on grade and exterior walls below grade as indicated. Tighten sleeve seal screws until sealing grommets have

expanded to form watertight seal.

### 3.2 INSTALLATION, ADDITIONAL REQUIREMENTS FOR RACEWAYS

#### A. General: Comply with the CEC and with the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. The strength of the support, including attachment to the building or structure, shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 pounds, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.
  - a. Raceway shall be supported and braced per OSP referenced on plans.
3. Install pipe straps, individual and multiple (trapeze-type) raceway hangers and riser clamps as necessary to support raceways. Provide U-channel and associated pipe channel straps, bolts, clamps, attachments, fasteners, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
  - a. Raceway run on surface of structure:
    - 1) For conduit run on building surface, use two-hole stamped steel pipe straps.
    - 2) For conduit runs on steel beams, use malleable iron pipe beam clamp bolted to beam.
  - b. Raceway suspended from structure:
    - 1) Support parallel runs of horizontal raceways together on trapeze-type hangers.
    - 2) Support individual horizontal raceway by separate pipe hangers.
4. Support spacing: Maximum spacing shall be as allowed by the CEC.
  - a. Additional support required at unsupported boxes and access fittings: Support exposed and concealed raceway within 1 foot of an unsupported boxes and access fittings. In horizontal runs, this support may be omitted where box or access fitting is independently supported and raceway termination is not made with chase nipples or threadless box connectors.
  - b. Additional support required for vertical runs: Arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on the raceway terminals. Provide riser clamps for conduit at floor lines.

### 3.3 INSTALLATION, ADDITION REQUIREMENTS FOR EQUIPMENT AND ENCLOSURES

- #### A. Support electrical equipment and enclosures as required to produce, as a minimum, the same structural safety factors as specified for raceway supports.
1. Provide metal channel racks for mounting equipment, devices, and enclosures including, but not limited to: transformers, panelboards, enclosed switches and motor controllers, control components, pull- and junction-boxes, and cabinets.
  2. Electrical equipment shall be seismically-braced and anchored to resist a horizontal force (including a simultaneous vertical force of one-third the horizontal values shown) acting in any direction using the following criteria:

Fixed equipment on grade:	33% of operating weight.
Fixed equipment on structure:	33% of operating weight.
Emergency power equipment* on grade:	50% of operating weight.
Emergency power equipment* on structure:	75% of operating weight.

\*Note: Also applicable to communications equipment.

For flexibly-mounted equipment, use twice the above values.

3. The anchorage of electrical equipment required for elevator drives, emergency generator, emergency motor loads, fire pumps and emergency lighting shall be designed in accordance with Section 2312 of the Uniform Building Code for a lateral force based on a "Cp" value.

### 3.4 FIELD QUALITY CONTROL

- A. Preparation for tests: Provide all jacks, jigs, fixtures, and calibrated indicating scales required for accurate, reliable testing. Obtain the Owner's Representative and Structural Engineer's approval before transmitting loads to the structure.
  1. Test to 90 percent of rated proof load for fasteners. If fastener fails test, revise all similar fastener installations and re-test until satisfactory results are achieved.
- B. Tests: Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:
  1. Expansion anchors.
  2. Powder-driven threaded studs.
  3. Toggle bolts.

### 3.5 CLEANING

- A. Clean surfaces to be painted.

END OF SECTION

**SECTION 26 05 33  
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes provision of a mechanically- and electrically-complete conduit system including:
1. Rigid metal conduit.
  2. Intermediate metal conduit.
  3. Electrical metallic tubing.
  4. Rigid nonmetallic conduit.
  5. Flexible metal conduit.
  6. Liquidtight flexible conduit.
  7. Wireways (and auxiliary gutters).
  8. Surface raceway.
  9. Fittings and conduit bodies; accessories.
- B. Related Sections:
1. General electrical requirements: Section 260500.
  2. Wire and cable: Section 260519.
  3. Wiring devices: Section 262726.
  4. Grounding and bonding: Section 260526.
  5. Supporting devices: Section 260529.
  6. Electrical identification: Section 260553.

1.2 REFERENCES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

- A. American National Standards Institute
- ANSI C80.1 Specification for Rigid Steel Conduit, Zinc-Coated.  
ANSI C80.3 Specification for Electrical Metallic Tubing, Zinc-Coated.  
ANSI C80.5 Rigid Aluminum Conduit.  
ANSI/NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- B. American Society for Testing and Materials.
- ASTM 123 Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
- C. CEC California Electrical Code.
- D. IEEE Institute of Electrical and Electronics Engineers.

- E. NECA National Electrical Contractors Association: "Standard of Installation."
- F. National Electrical Manufacturers Association
  - NEMA RN 1 PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - NEMA TC 2 Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
  - NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.
  - NEMA TC 6 PVC and ABS Plastic Utilities Duct for Underground Installation.
  - NEMA TC 9 Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.
- G. NFPA National Fire Protection Association
- H. Underwriters Laboratories, Inc.
  - UL 1 Flexible Metal Electrical Conduit
  - UL 6 Rigid Metal Electrical Conduit.
  - UL 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
  - UL 360 Liquidtight Flexible Steel Conduit, Electrical.
  - UL 514B Fittings for Conduit and Outlet Boxes.
  - UL 651 Rigid Nonmetallic Electrical Conduit.
  - UL 797 Electrical Metallic Tubing.
  - UL 1242 Intermediate Metal Conduit

### 1.3 SUBMITTALS

- A. General: Submit the following in accordance with the Conditions of the Contract and Division 1 Specification Sections, and Section 260500.
- B. Product data: For all raceway products.
- C. Contractor shall be responsible for anchors and connections of electrical work to building structure to prevent damage as a result of earthquake, including the connection and integrity of field-fabricated materials and equipment. All building connections therefore shall be designed to resist seismic forces in conformance with Title 24 of the California Administrative Code.

Contractor shall submit shop drawings sealed by a Structural Engineer registered in the State of California to demonstrate compliance with the following requirement:

All raceway shall be supported and braced per OSP included/referenced in design drawings.

- D. Samples: Provide samples upon specific request
- E. Installation instructions: Manufacturer's written installation instructions for wireway, surface raceway, and nonmetallic raceway products. Include instructions for storage, handling, protection, examination, and preparation of Product.
- F. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches.
- G. Substitutions: If materials are by manufacturers other than those specified, submit product

data giving complete description for sizes employed, material types, and installation methods.

H. Certificates:

1. Labels of Underwriters' Laboratories, Inc. affixed to each item of material.
2. If materials are by manufacturers other than those specified, submit certification what material meets applicable Underwriters' Laboratories, Inc. Standards.

1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with CEC, "California Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation".
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500.
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate with other Work:

1. Install conduits before concrete is placed, and in advance of masonry work.
2. Install conduits through roof in time to be flashed prior to roofing application.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

Subject to compliance with requirements, provide products by the following, or equal:

#### **A. Conduit Bodies:**

Adalet-PLM  
Appleton Electric  
Carlton  
Crouse Hinds  
Killark Manufacturing  
OZ/Gedney  
Spring City Electrical Mfg.

#### **B. Wireway and Auxiliary Gutters:**

B-Line  
Square D  
Wiremold

#### **C. Surface Nonmetallic Raceway:**

Carlton  
Hubbell  
Panduit  
Wiremold

### **2.2 METAL CONDUIT AND TUBING**

#### **A. Rigid Metal Conduit: Steel, hot-dipped galvanized including the threads, with an outer coating of zinc bichromate, complete with one coupling and one end thread protector, manufactured in accordance with ANSI C80.1 and UL 6.**

1. Threaded, hot-dipped galvanized fittings manufactured in accordance with ANSI C80.4.
2. Where indicated, provide galvanized rigid steel conduit and fittings with polyvinyl chloride (PVC) coating of nominal .020 inch (20 mil ) thickness conforming to NEMA Standard No. RN-1, Type A, Robroy Industries, or equal.

#### **B. Intermediate Metal Conduit: Hot-dipped galvanized steel including the threads, manufactured in accordance with UL 1242.**

#### **C. Electrical Metallic Tubing: Welded, electro-galvanized thin wall steel tubing, manufactured in accordance with ANSI C80.3 and UL 797.**

1. Maximum size shall be 2 inches.



2. Provide compression type fittings in all areas.
  - a. Gland compression type, zinc plated steel body, cadmium plated malleable iron nut, O-Z/Gedney
  - b. Indenter type or set screw fitting are not acceptable.
- D. Flexible metal Conduit: Hot-dipped galvanized steel interlocking, single-strip type manufactured in accordance with UL1.
  1. Squeeze type, malleable iron, cadmium plated, straight and angle connectors for all sizes and twist-in connectors for 1/2-inch and 3/4-inch flexible metal conduit.
  2. Integral copper ground wire on sizes 1-1/4" and smaller.
- E. Liquidtight Flexible Conduit: Hot-dipped galvanized steel strip core with extruded liquid-tight polyvinyl jacket. Use O-Z/Gedney Type UAG, or equal.
  1. Liquid-tight fittings. ANSI/NEMA FB 1.
  2. Connectors: Cadmium plated malleable iron body and nut, cadmium plated steel ferrule, insulated throat, integral cast external ground lug, O-Z/Gedney.

## 2.3 CONDUIT BODIES

### A. General

1. Types, shapes, and sizes as required to suit individual applications and CEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

### B. Metallic Conduit and Tubing

1. Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.

## 2.4 WIREWAYS AND AUXILIARY GUTTERS

- ### A. General:
- Electrical wireways shall be of types, sizes, and number of channels as indicated. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system. Where features are not indicated, select for fulfill wiring requirements comply with applicable provisions of CEC.

### B. Wireways covers shall be hinged type.

1. Use sheet steel wireways with screw-on covers and corrosion resistant hardware. For dry locations coat with rust inhibitor and finish with gray baked enamel. For wet locations use hot-dipped galvanized material finished with gray baked enamel, provide gaskets for covers.

## 2.5 SURFACE RACEWAY

### A. General

1. Sizes and channels as indicated. Provide fittings that match and mate with raceway.

B. Surface Metal Raceway

1. Construct of galvanized steel with snap-on covers, with 1/8-inch mounting screw knockouts in base approximately 8 inches o.c. Finish with manufacturer's standard prime coating suitable for painting. Provide raceways of types suitable for each application required. Provided by Hoffman Engineering Co., The Wiremold Co., or approved equal.

C. Surface Nonmetallic Raceway

1. Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color. Raceway and system components shall meet UL 94 requirements for nonflammable, self-extinguishing characteristics. Provided by Hubbell, Inc., Panduit Corp., The Wiremold Co., or approved equal.

2.6 ACCESSORIES

- A. General: Reducers, bushings, washers, etc., shall be cadmium plated malleable iron of the shape and dimension best suited for the application.

- B. Seals for Walls and Floor Penetrations: Malleable iron body, oversize sleeve, sealing ring, pressure clamp and rings and sealing grommet, hex head cap screws, O-Z/Gedney Type FSK, or equal.

- C. Fire Seals: Heat activated intumescent material, elastomeric sealing ring, socket head cap screws, steel pressure discs and flange, O-Z/Gedney Type CFSF, Nelson Flame Seal, or equal.

- D. End bells: Hot-dipped galvanized, threaded malleable iron, O-Z/Gedney Type THS, or equal.

E. Bushings:

1. 1-1/4" and smaller: High-impact thermo-setting phenolic, 150°C, O-Z/Gedney Type "A", or equal.
2. 1-1/2" and larger: Hot-dipped galvanized with thermosetting phenolic insulation, 150°C, O-Z/Gedney Type "B", or equal.

F. Locknuts:

1. 1-1/2" and smaller: Zinc plated heavy stock steel, O-Z/Gedney, or equal.
2. 2" and larger: Cadmium plated malleable iron, O-Z/Gedney, or equal.

- G. Hubs: Cadmium plated malleable iron, tapered threads, neoprene "O" ring, insulated throat, O-Z/Gedney, or equal.

- H. Expansion Fittings: Hot-dipped galvanized malleable iron with bonding jumpers.

1. Linear: O-Z/Gedney Type AX and TX, or equal.
2. Linear, with deflection: O-Z/Gedney Type AXDX, or equal.

- I. Escutcheons: Chrome plated sectional floor and ceiling plates, Crane No. 10, or equal.

### **PART 3 - EXECUTION**

#### **3.1 WIRING METHOD**

- A. General: The wiring method shall be as follows, except as otherwise noted.
- B. Interior:
  1. Exposed: Electrical metallic tubing.
    - a. Areas where exposed conduit may be subject to physical damage: Rigid metal conduit.
    - b. Damp or wet locations: Rigid metal conduit.
    - c. Classified locations: Rigid metal conduit.
  2. Concealed: Electrical metallic tubing.
    - a. In or under slab on grade: Nonmetallic conduit, Schedule 40 PVC. Conduit leaving the slab (including exposed conduit riser) shall be rigid steel conduit.
    - b. In slab, above grade: Rigid nonmetallic conduit Schedule 40 PVC. Maximum size conduit in slab: 1 inch.
  3. Connection to vibrating equipment, including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment: Flexible metal conduit, maximum length 18 inches.
    - a. For moist or humid locations or corrosive atmosphere, or where subject to water spray or dripping oil, grease, or water: Liquidtight flexible metal conduit.

#### **3.2 INSTALLATION**

- A. General Requirements:
  1. Install electrical raceways in accordance with manufacturer's written installation instructions, applicable requirements of CEC, and as follows.
    - a. Minimum size: 3/4 inch unless otherwise indicated.
    - b. Size conduits as indicated on the drawings and as required by the CEC for the number and sizes of wires to be installed into the conduit.
    - c. Make conduit field cuts square with saw and ream out to full size. Shoulder conduits in couplings. Remove burrs, and swab inside conduits before conductors are pulled in.
    - d. Make all conduit joints mechanically tight, electrically continuous, and watertight. Pitch conduits in a manner to avoid creating moisture traps.
    - e. Install minimum 3/16" polypropylene pull cords from end-to-end in all empty raceways, tagged with the identification of service intended and location of opposite end. Leave at least 24 inches of pull cord at each end.
    - f. Restore wall, ceiling, and floor penetrations to the requirements of the Authority Having Jurisdiction.
    - g. Provide supports for raceways as specified in Section 26 05 29, Supporting

Devices.

- 1) All raceway shall be supported and braced per OSP listed/referenced on the design drawings.
- h. Provide code sized green grounding conductor in all non-metallic conduit.
2. Complete installation of electrical raceways before starting installation of conductors within raceways.
  - a. Protect inside of conduit from dirt and rubbish during construction by capping all openings with plastic caps intended for the purpose. Cap or plug conduits with standard manufactured accessories as soon as the conduits have been permanently installed in place.
3. Install all conduits at elevations and locations to avoid interference with grading or other work, the structure, finished ceilings, walls. Avoid causing cutting of masonry structural members.
  - a. Do not place conduits in close proximity to equipment, systems, and service lines, such as hot water supply and return lines, which could be detrimental to the conduit and its contents. Maintain a minimum 3" separation, except in crossing, which shall be a minimum 1".
    - 1) Minimum separation from uninsulated hot water pipes, steam pipes, heater flues or vents: 6 inches. Avoid running conduit directly under water lines.
    - 2) Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.
4. Conceal conduit, unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least six (6) inches away from parallel runs of flues and steam or hot water pipes. Install raceway level and square and at proper evaluations.
  - a. To prevent displacement, securely support and hold in place all conduits installed in advance of other work and to be concealed in the building structure. Carefully lay out conduits run within the structure, such as floors, beams, walls, to avoid densities excessive for the construction. Relocate those conduits when excessive densities occur.
  - b. Run conduits embedded in structural slabs in the middle of the slab below the top and above the bottom reinforcing steel. Minimum cover for conduit in concrete floors, walls or roof: 1/3 thickness of slab, but in no case less than 1-1/2" cover except where penetration is made. Do not install conduit larger than 1" in slabs. Tie raceways to reinforcing rods or otherwise secure them to prevent sagging or shifting during concrete placement. Space raceways laterally to prevent voids in the concrete. Where nonmetallic conduit is used, raceways must be converted to Schedule 80 or rigid steel conduit before rising above the floor.
  - c. Where conduit installed in concrete or masonry extends across building construction joints, provide expansion fittings as manufactured by O.Z.; Crouse-Hinds; Appleton; or equal, with approved ground straps and clamps. Expansion fittings installed in concrete shall be watertight - concrete tight deflection/expansion type.
  - d. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated. This does not apply to conduits in crawl spaces.

5. Install and neatly rack exposed conduits parallel with and perpendicular to building walls. Do not install exposed diagonal conduit runs.
  - a. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases provide field bends for parallel raceways.
  - b. Use blockouts for concentrations of conduits in a confined area.
  - c. Route and suspend conduits crossing expansion joints to permit expansion, contraction, and deflection utilizing approved fittings to prevent damage to the building, conduits, and supporting devices.
  - d. Install exposed raceways parallel and perpendicular to nearby surfaces of structural members and follow the surface contours as much as practical.
  - e. Provide conduit bodies for exposed conduit runs at junctions, bends or offsets where required. Do not use elbows or bends around outside corners of beams, walls or equipment. Make conduit body covers accessible.
6. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.
7. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
  - a. Make no bends with a radius less than 12 times the diameter of the cable it contains nor more than 90 degrees. Make field bends with tools designed for conduit bending. Heating of metallic conduit to facilitate bending is not permitted.
  - b. Bends and offsets in 1" and smaller conduits may be done with approved bending devices. Do not install conduits which have had their walls crushed and deformed and their surface finish damaged due to bending.
  - c. Run conduits parallel to and at right angles to building lines.
  - d. Where space conditions prohibit the use of standard ells, elbows, and conduits, use cast ferrous alloy fittings of such forms and dimensions as best required for application.
8. Surface Raceway:
  - a. Install a separate green ground conductor in raceway from the junction box supplying the raceway to receptacle of fixture ground terminals.
  - b. Select each surface raceway outlet box to which a lighting fixture is attached to be of sufficient diameter to provide a seat for the fixture canopy.
  - c. Where a surface raceway is used to supply a fluorescent lighting fixture having central stem suspension with a backplate and a canopy, with or without extension ring, the backplate and canopy will serve as the outlet box and no separate outlet box need be provided.
  - d. Provide surface raceway outlet box, in addition to the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end stem

- suspension.
- e. Where a surface raceway extension is made from an existing outlet box on which a lighting fixture is installed, provide a backplate slightly smaller than the fixture canopy, and no additional surface mounted outlet box need be installed.
  - f. Surface raceways shall be securely fastened to the mounting surface. Use expansion type anchors in concrete.
9. Do not run conduits exposed on the roof unless approval is obtained from the Owner prior to installation.

B. Other Requirements:

1. Connect motors, equipment containing motors, equipment mounted on an isolated foundation, transformers, and other equipment and devices which are subject to vibration and which require adjustment with flexible metallic conduit from the device to the conduit serving it. Size the flexible conduit length more than 12 diameters, but less than 18 diameters. Rigidly support the points of attachment on each side of the connection. Use external bonding jumpers on sizes 1-1/2" and above.
2. Install escutcheons on all exposed conduits passing through interior floors, walls, or ceilings. Install fire seals on all conduits passing through fire rated partitions. Install wall and floor fire seals on all conduits passing through exterior walls and floors, or use standard galvanized steel pipe sleeves; diameters 12" greater than the outside diameter of the sleeved conduit and fill the annular space with mastic or caulk with lead.
3. Raceway for panelboards:
  - a. All homeruns shown shall be run to the panel indicated independently of all other homeruns. Provide pull points so as not to exceed total bends of 270 degrees.
  - b. Run a minimum of one 3/4-inch empty conduit for every three single pole spare circuit breakers, spaces or fraction thereof and not less than two 3/4-inch conduits from every flush mounted panel to an accessible space above the ceiling and below the floor.
4. Make conduit projections from covered areas to areas exposed to the weather watertight by proper flashing. Extend flashing a minimum of 6 inches in all directions from conduit.
5. Terminations:
  - a. Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.
  - b. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
  - c. At switchboards, manholes and floor standing distribution panelboards, provide insulated throat bushings or bell ends on all non-metallic conduit entries and bushings on all metallic conduit entries.
  - d. Install insulated throat threaded hubs on conduits entering enclosures without

- threaded hubs.
- e. Install end bells on conduits stubbed through slabs and foundations into electrical enclosures.
6. Flexible Connections: Use short length (maximum of 6 feet) of flexible conduit for recessed and semi-recessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet locations. Install separate ground conductor across flexible connections.
  7. PVC Coated Rigid Steel Conduit:
    - a. Do not store conduit in direct sunlight.
    - b. Use pipe straps, no pipe wrenches or channel wrenches, when tightening connections to avoid damaging PVC coating.
    - c. Patch all gouges or cuts in the PVC coating after installing conduit. Use manufacturer's recommended patching paste. Build up area to be patched to full mil thickness of coating and feather out paste on sides of damaged area a minimum of 1/2-inch to provide a completely bonded seal.
    - d. Field bend conduit with shoes for a mechanical bender sized for the next larger size conduit.
    - e. Bends used in or below concrete slabs shall be, rigid steel type elbows, use for all stub-ups with flush floor coupling at transitions.
  8. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.

### 3.3 FIELD QUALITY CONTROL

- A. Examine surfaces to which conduits are to be secured for:
  1. Defects which will adversely affect the execution and quality of work.
  2. Deviations from allowable tolerances for the building material.
- B. Do not start work until defects and deviations are corrected.

### 3.4 CLEANING

- A. Upon completion of installations of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

### 3.5 PROTECTION OF FINISHED WORK

- A. Protect inside of conduit from dirt and rubbish during construction by capping all openings with plastic caps intended for the purpose.
- B. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

## END OF SECTION





**SECTION 26 05 33.13  
ELECTRICAL CABINETS AND ENCLOSURES**

**PART 1 - GENERAL**

1.1 SUMMARY

A. This Section includes:

1. Outlet and device boxes.
2. Pull and junction boxes.
3. Floor boxes and service fittings.
4. Boxes and fittings for hazardous locations.
5. Cabinets.
6. Hinged door enclosures.

B. Related Sections:

1. Raceways: Section 260533.
2. Wiring devices: Section 262726.
3. Grounding and bonding: Section 260526.
4. Supporting devices: Section 260529.
5. Electrical identification: Section 260553.

C. The following related items are specified in Section 260533 - Raceways: conduit-body-type electrical enclosures and wiring fittings, wireways, and auxiliary gutters.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. ANSI American National Standards Institute.

2. American Society for Testing and Materials.

ASTM 123 Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.

ASTM 167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

3. IEEE Institute of Electrical and Electronics Engineers.

4. CEC California Electrical Code.

5. National Electrical Manufacturers Association.

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).

NEMA ICS6 Enclosures for Industrial Controls and Systems.

NEMA OS1 Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.

NEMA OS2 Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.

6. NFPA National Fire Protection Association

7. Underwriters Laboratories, Inc.

UL 50 Electrical Cabinets and Boxes.

UL 514A Electrical Metallic Outlet Boxes.

UL 514B Fittings for Conduit and Outlet Boxes.

UL 514C Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers.

UL 886 Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

### 1.3 SUBMITTALS

- A. In addition to this Section, the submittal requirements of Section 260500 are applicable.
- B. Product data: Boxes, cabinets, and fittings.
- C. Shop drawings: Provide for boxes, cabinets, and enclosures that are to be shop fabricated (non-stock items). For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions and finishes. For cabinets and hinged enclosures, drawings shall include dimensions, knockout sizes and locations, material types and gauges, finishes, and installation method.
- D. Certificates shall include labels of Underwriters' Laboratories, Inc., and National Electrical Manufacturer's Association affixed to each item.
- E. Record actual locations and mounting heights of outlet-, pull-, and junction-boxes, and cabinets and hinged door enclosures, on project record documents.

### 1.4 DEFINITIONS

- A. Cabinet: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.
- B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.
- C. Enclosure: A box, case, or cabinet, or housing for electrical wiring or components.
- D. Hinged Door Enclosure: An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.
- E. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.
- F. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or of switches for controlling electrical circuits.

### 1.5 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.

- B. Electrical Component Standard: Components and installation shall comply with CEC, "California Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

#### 1.7 PROJECT CONDITIONS AND SITE CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify locations of boxes, cabinets, and enclosures prior to rough-in.
- C. Placement shown on Drawings in approximate locations unless dimensioned. Install as required to complete wiring system.

#### 1.8 SEQUENCING

- A. Install boxes, cabinets, and enclosures in coordination with other work, and at times required to prevent delays in the work and to avoid cutting of masonry units.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

Subject to compliance with requirements, provide products by the following, or equal:

##### A. General:

Appleton Electric Company  
Hubbell  
Steel City  
O.Z./Gedney  
Hoffman  
Circle AW

##### B. Boxes and fittings for hazardous locations:

Crouse Hinds  
Killark Electric Mfg.  
Robroy Industries

Spring City Electrical Mfg.  
Woodhead Industries

C. Floor Boxes:

Hubbell  
Raco  
Thomas & Betts  
Walker  
Wiremold

D. Cabinets:

Circle AW  
Hoffman Engineering  
Spring City Electrical Mfg.

## 2.2 GENERAL

Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

A. Materials and Finishes:

1. Sheet steel: Flat-rolled, code-gauge, galvanized steel.
2. Fasteners for general use: Corrosion-resistant screws and hardware, including cadmium and zinc-plated items.
3. Fasteners for wet or damp locations: Stainless steel screws and hardware.
4. Cast metal for boxes, enclosures and covers: Copper-free aluminum except as otherwise indicated.
5. Exterior finish: Gray-baked enamel for items exposed in finished locations except as otherwise indicated.
6. Painted interior finish: Where indicated, white baked enamel.
7. Fittings for boxes, cabinets, and enclosures: Conform to UL 514B. Malleable iron or zinc-plated steel for conduit hubs, bushings and box connectors.

## 2.3 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

- A. General: Conform to UL 514A and UL 514B. Boxes shall be of type, shape, size, and depth to suit each location and application.
- B. Steel Boxes: NEMA OS 1. Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.
- C. Cast Aluminum Boxes: Copper-free aluminum with gasketed covers, threaded raceway entries, and features and accessories suitable for each location including mounting ears, threaded screw

holes for devices and closure plugs.

- D. Cast Iron Boxes: Iron alloy, waterproof, with gasketed covers and threaded raceway entries, and features and accessories suitable for each location including mounting ears, threaded screw holes for devices and closure plugs.
- E. Floor Boxes:
  - 1. Cast Iron Floor Boxes: Fully-adjustable, waterproof, with threaded raceway entrances, adjusting rings, gaskets, and brass floor plates. Where indicated, provide multi-section boxes with individual hinged section covers and provide for a duplex receptacle under one or more of the covers.
  - 2. Steel Floor Boxes: Sheet steel, concrete tight, fully adjustable, with stamped knockouts, adjusting rings, and brass floor plates. Where indicated, provide multi-section boxes with concealed individual section covers under a common flush floor plate. Provide for a duplex receptacle in one of the concealed section covers and a one inch diameter bushed opening in the other.
  - 3. Service Fittings for Floor Outlet Boxes: Surface mounted horizontal, cast aluminum type, three inches high, suitable for finished spaces and finished in stain aluminum, except where otherwise indicated. Provide duplex receptacle or one inch diameter bushed opening for telephone or other communications service as indicated. Equip fitting for attaching flat to floor box cover.

#### 2.4 NONMETALLIC OUTLET, DEVICE, AND SMALL WIRING BOXES

- A. General: Conform to NEMA OS 2, and UL 514B and 514C. Boxes shall be high-impact resistant molded PVC units with covers and integrally-molded raceway entrance hubs and removable mounting flanges. Boxes shall be equipped with threaded screw holes for device and cover plate mounting, be equipped with an integral ground lug, and be of the type, shape, size, and depth to suit location and application.
  - 1. Boxes for Concealed Work: Mounting provisions and wiring entrances to suit installation conditions and wiring method used.
  - 2. Boxes for Exposed Work: Ultraviolet-stabilized, non-conductive, high impact-resistant boxes with integrally-molded raceway entrance hubs and removable mounting flanges. Boxes shall be equipped with threaded screw holes for device and cover plate mounting. Each box shall have a molded cover of matching PVC material suitable for the application.

#### 2.5 PULL AND JUNCTION BOXES

- A. General: Conform to UL 50, for boxes over 100 cubic inches in volume. Boxes shall have bolted-on covers of material same as box, and shall be of the size and shape to suit the application.
- B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.
- C. Hot-Dip Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanize after fabrication. Cover shall be gasketed.
- D. Stainless Steel Boxes: Fabricate of stainless steel conforming to Type 302 of ASTM A 167. Where

necessary to provide a rigid assembly, construct with internal structural stainless steel bracing. Cover shall be gasketed.

- E. Cast Iron Boxes: Molded of cast iron alloy with gasketed cover and integral threaded conduit entrances.
- F. Cast Nonmetallic Boxes: Ultraviolet stabilized, non-conductive, high impact-resistant PVC boxes with gasketed cover and integral mounting flanges.
- G. Boxes Approved for Classified Locations: UL 886. Cast metal or cast nonmetallic boxes, listed and labeled for use in the specific location classification, and with the specific hazardous material encountered. Conduit entrances shall be integral threaded type.

## 2.6 CABINETS

- A. General: Conform to UL 50.
- B. Construction: Sheet steel, NEMA 1 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one-piece frame and hinged door. Arrange door to close against a rabbet placed around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24 inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24 inches apart and not over 6 inches from top and bottom of door. For flush cabinets, make the front approximately 3/4 inch larger than the box all around. For surface mounted cabinets make front same height and width as box.
- C. Doors: Double doors for cabinets wider than 24 inches. Telephone cabinets wider than 48 inches may have sliding or removable doors.
- D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks shall be of a type to permit doors to latch closed without locking.

## 2.7 STEEL ENCLOSURES WITH HINGED DOORS

- A. General: Conform to UL 50.
- B. Construction: Sheet steel, 16 gauge minimum, with continuous welded seams. NEMA class as indicated, arranged for surface mounting.
- C. Doors: Hinged directly to cabinet and removable, with approximately 3/4 inch flange around all edges, shaped to cover edge of box. Provide handle-operated key locking latch. Individual door width shall be no greater than 24 inches. Provide multiple doors where required.
- D. Mounting Panel: Provide painted removable internal mounting panel for component installation.
- E. Enclosure: NEMA 12, except as indicated. Where door gasketing is required, provide neoprene gasket attached to oil-resistant adhesive, and held in place with steel retaining strips. For all enclosures of class higher than NEMA 1, use hubbed raceway entrances.

## 2.8 CAST METAL ENCLOSURES WITH HINGED DOORS

- A. Copper-free aluminum with bolted, hinged doors. Where used at classified locations, enclosures shall conform to UL and shall be listed and labeled for the classification of hazard involved.

## 2.9 MOLDED NONMETALLIC ENCLOSURES WITH HINGED DOOR

- A. General: Molded, glass fiber reinforced high impact strength polyester with bolt or screw-secured doors and solid neoprene gaskets.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements, except as otherwise indicated:
  - 1. Interior dry locations: NEMA type 1, sheet steel.
    - a. In dry walls for single and two gang outlets provide 4S and 4D boxes, for 3 or more outlets use masonry boxes.
    - b. In block and masonry walls provide masonry boxes of depths required for wall thickness.
    - c. In poured concrete and plastered walls provide 4S and 4D boxes for single gang outlets and 2G and 3G-5075 boxes for multiple ganged outlets.
    - d. In concrete ceilings provide OCR rings. In other ceilings provide 40 and 40D boxes. Omit covers if standard canopy and device plates entirely cover the ceiling opening.
  - 2. Locations exposed to weather or dampness: Cast metal, NEMA type 3R.
  - 3. Wet locations: NEMA type 4 enclosures.
    - a. In exposed work, exterior of buildings, in wet location, and flush in non-waterproofed walls below grade provide FS and FD boxes.
  - 4. Corrosive locations: NEMA type 4X enclosures.
  - 5. Hazardous (Classified) locations: Cast metal, UL 886, NEMA type listed and labeled for the location and class of hazard indicated.
- B. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types as follows, except as otherwise indicated:
  - 1. Interior dry locations: NEMA type 1, sheet steel.
  - 2. Locations exposed to weather or dampness: NEMA type 3R, sheet steel.
  - 3. Wet locations: NEMA type 4 enclosures.
  - 4. Corrosive locations: NEMA type 4X enclosures.
  - 5. Hazardous (Classified) locations: Cast metal, UL 886, NEMA type listed and labeled for the location and class of hazard indicated.
- C. Floor Boxes: In slabs on grade and wet locations: Use NEMA type 4 boxes. At other locations in slabs, use concrete-tight NEMA 1 boxes.
  - 1. Provide floor boxes with quantity of gangs as required for power, communication or control as indicated. Use boxes with barriers where required. Provide carpet flanges in carpeted areas.

- D. Hinged Door Enclosures: NEMA type 12, except as indicated.
- E. Hinged Door Enclosures Outdoors: NEMA type 3R, with drip hood, factory tailored to individual units.
- F. Hinged Door Enclosures in Corrosive Locations: NEMA type 4X [metal] [nonmetallic] enclosure.
- G. Cabinets: Flush mounted, NEMA enclosure type 1, except as otherwise indicated.

### 3.2 INSTALLATION, GENERAL

- A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.
- B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs. Provide standard manufactured plugs in unused openings of boxes.
- C. Support and fasten items securely in accordance with Section 260529, "Supporting Devices."
- D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.
- E. Remove sharp edges where they may come in contact with wiring or personnel.
- F. Do not provide through-the-wall and back-to-back boxes. Provide minimum 24" between outlet boxes on all fire-rated walls.
- G. Provide boxes at the terminal of conduit runs to outlets and devices.
- H. Center outlets in paneling and in other Architectural features.
- I. Locate light fixture outlets in uniform relation with ceiling tiles.
- J. Group outlets on circuits with homeruns as indicated on the drawings.
- K. Provide plaster rings and covers where required by the building structure.

### 3.3 INSTALLATION OF OUTLET BOXES

- A. Outlets at windows and doors: Locate close to window trim. For outlets indicated above doors, use 6 feet-9 inches mounting height above finished floor and center outlets above the door opening except as otherwise indicated.
- B. Column and pilaster locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.
- C. Locations in special finish materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Sawcut all recesses for outlet boxes in exposed masonry walls.
  - 1. Provide 1" deep plaster rings on recessed outlet boxes installed in areas where concrete will be exposed after construction is complete.



2. Where boxes are concealed in exposed concrete unit masonry, use square cornered type boxes, or boxes fitted with rings of sufficient depth for the box to be recessed completely within cavity of block or tile. Install box to insure that ring fits an opening sawed out of the masonry, so that no mortar is required to fill between ring and construction.
- D. Gasketed boxes: At the following locations use cast metal, threaded hub-type boxes with gasketed weatherproof covers:
1. Exterior locations.
  2. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations.)
  3. Where exposed to moisture-laden atmosphere.
  4. At food preparation equipment within four feet of steam connections.
  5. Where indicated.
- E. Cast iron boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.
- F. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles either vertically or horizontally but consistently either way. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side.
1. Provide 3/8 inch studs in ceiling- and wall-mounted lighting fixture outlet boxes where shop drawings of fixtures require and elsewhere as may be required for fixtures.
- G. Ceiling outlets: For fixtures, where wiring is concealed, use octagonal outlet boxes, 4 inches by 2 inches deep, minimum.
- H. Cover plates for surface boxes: Use plates sized to box front without overlap.
- I. Protect outlet boxes to prevent entrance of plaster and debris. Thoroughly clean foreign material from boxes before conductors are installed.
- J. Floor boxes: Install in concrete floor slabs so they are completely enveloped in concrete except for the top. Where normal slab thickness will not envelop box as specified above, provide increased thickness of the slab. Provide each compartment of each floor box with grounding terminal consisting of a washer-in-head machine screw, not smaller than No. 10-32, screwed into a tapped hole in the box. Adjust covers of floor boxes flush with finished floor.

### 3.4 INSTALLATION OF PULL AND JUNCTION BOXES

- A. Pull boxes and junction boxes shall be securely mounted to the building structure.
1. Fastenings shall be made by means of not smaller than 3/16" diameter bolts, expansion bolts, or toggle bolts; not smaller than No. 9" x 1" wood screws; or by equivalent fastenings; where

exposed to weather or moisture, shall be galvanized. Do not use nails, or wood or fiber inserts in masonry.

2. On masonry or concrete walls, columns or flooring, fastenings shall be made by means of lead expansion shields not smaller than size 3/8" diameter by 5/8" long for use with No. 10-24 round head machine screws. Machine screws shall be not less than 1-1/4" long for installation on ceiling and not less than 1" long elsewhere.

- a. Holes for lead expansion shields shall be carefully and accurately drilled, using sharp drills to a depth which will afford the maximum practical engagement of threads (depth equal to screw length not less than 1-1/4" past plaster into solid concrete). Installation shall develop full strength of screw.

- B. Pullboxes for concealed wiring shall be mounted flush in walls, partitions, and ceilings, unless otherwise indicated.

1. Use cast iron boxes flush in slab on grade.

- C. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8-inches square by 4-inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box.

- D. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30 inches inside boxes.

- E. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.

- F. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by NEC Article 370, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems.

### 3.5 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES

- A. Installations shall be secure and substantial; cabinets shall be attached to building walls or structure.

- B. Mount with fronts, trim, and doors straight and plumb.

- C. Install with tops 78 inches above finished floor.

- D. Set cabinets in finished spaces flush with walls.

- E. Identification: Provide identification nameplates on inside and outside of covers and doors on each cabinet and hinged enclosure, engraved bakelite with 1/4 inch minimum height letters, securely fastened with stainless steel screws. Text shall identify the function of the cabinet or enclosure, for example, "Dimming Panel," unless otherwise indicated.

### 3.6 GROUNDING

- A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box, or enclosure.

### 3.7 CLEANING AND FINISH REPAIR

- A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris

and repair damaged finish including chips, scratches, abrasions and weld marks. Clean surfaces to be painted.

- B. Galvanized finish: Repair damage using a zinc-rich paint recommended by the manufacturer.
- C. Painted finish: Repair damage using matching corrosion-inhibiting touch-up coating.

END OF SECTION



**SECTION 26 05 43**  
**UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

A. Section includes:

1. Ducts.
2. Ductbanks.
3. Manholes, handholes, and precast concrete pullboxes.
4. Warning tape
5. Conduit Markers

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 2 Section "Earthwork," for general requirements for excavation, backfill, and related items for ducts, manholes, handholes, and precast concrete pullboxes.
2. Division 3 Section "Concrete Work," for cast-in-place concrete requirements.
3. Division 7 Section "Bituminous Waterproofing," for waterproofing of manholes and handholes.
4. Raceways: Section 260533.
5. Boxes, cabinets, and fittings: Section 260533.13.
6. Grounding and bonding: Section 260526.
7. Supporting devices: Section 260529.
8. Electrical identification: Section 260553.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. American Association of State Highway and Transportation Officials

AASHTO HB14  
AASHTO H20  
AASHTO M198

2. American National Standards Institute.

ANSI C2           National Electrical Safety Code.  
ANSI C80.1       Specification for Rigid Steel Conduit, Zinc-Coated.  
ANSI/NEMA FB 1   Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

3. American Society for Testing and Materials.

A48-94A Gray Iron Casting  
A123-89a Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged steel shapes, Plates, Bars, and Strips.

A153-95 Zinc Coating (Hot Dip) on Iron and Steel Hardware  
A569/A569-91a Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled,  
Commercial quality.  
C478M-95 Specification for Precast Reinforced Concrete Manhole Sections  
ASTM C 478 Specification for Precast Reinforced Concrete Manhole Sections.  
ASTM C 891 Practice for Installation of Underground Precast Concrete Utility Structures.  
ASTM 123 Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from  
Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.

4. Federal Specification [from General Services Administration]

FS RR-F-621 Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole.

5. CEC California Electrical Code.

6. IEEE Institute of Electrical and Electronics Engineers.

7. National Electrical Manufacturers Association.

NEMA RN 1 PVC Externally-Coated Galvanized Rigid Steel Conduit and Intermediate Metal  
Conduit.

NEMA TC 2 Electrical Plastic Tubing and Conduit

NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing

NEMA TC 6 PVC and ABS Plastic Utilities Duct for Underground Installation.

NEMA TC 8 Extra-Strength PVC Plastic Utilities Duct for Underground Installation.

NEMA TC 9 Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.

NEMA TC 10 Duct for Underground Installation, PVC, and ABS Plastic Communications

8. NFPA National Fire Protection Association

9. State of California Administrative Codes (CAC)

CAC Part 3, Title 24, CCR, 1998 California Electrical Code

10. State of California Public Utilities Commission (Cal. P.U.C.)

PUC G.O. 128 Rules for Construction of Underground Electrical Supply and Communication  
Systems

11. Underwriters Laboratories, Inc.

UL 514B Fittings for Conduit and Outlet Boxes

UL 651 Schedule 40 and 80 PVC Conduit.

UL 651A Type EB and A Rigid PVC Conduit and HDPE Conduit

### 1.3 GENERAL

- A. Raceway sizes are minimum allowable based upon NEC requirements when using the cable insulation indicated. Contractor may increase conduit size at contractor's discretion and at no additional cost to facilitate cable pulling.

### 1.4 SUBMITTALS

- A. In addition to this Section, the submittal requirements of Section 260500.

- B. Shop Drawings: Indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast manholes, handholes, and pullboxes.
- C. Product Data: Provide for conduit and duct, warning tapes, duct spacers, conduit markers, and manhole, handhole, and pullbox accessories.
- D. Manufacturer's Instructions: Include instructions for storage, handling, protections, examination, preparation, and installation.

#### 1.4 PROJECT CONDITIONS

- A. The drawings are diagrammatic and shall not be scaled for exact locations. The location of existing underground and overhead utilities are based on record drawings and casual field observations. The contractor shall use reasonable care in excavating for the installation of new underground ducts and shall be responsible for damage to existing underground utilities. Field conditions and non-interference with other utilities and trades, shall determine exact locations of new underground electrical and communication ducts.
- B. Conduit routing shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring systems.

#### 1.5 DEFINITIONS

Duct: The general term for electrical conduit and other raceway, either metallic or nonmetallic, specified for use underground, embedded in earth or concrete.

Duct Bank: A group of two or more ducts in a continuous run between two points.

Handhole: A below-the-surface enclosure in connection with ducts into which people reach, but do not enter, for the purpose of installing, operating, or maintaining equipment or wiring.

Manhole: A below-the-surface enclosure or chamber, large enough for a person to enter, connecting with ducts, and affording facilities for installing, operating, and maintaining equipment or wiring.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record locations of exact routing of ductbank(s) indicating plan location and depths every 50 linear feet. Measure conduit locations from permanently fixed readily discernible landmarks such as building corners, columns, manhole centerline, etc..
- B. Accurately record actual locations of each pullbox, handhole and manhole.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with a minimum of three years documented experience.

#### 1.7 QUALITY ASSURANCE

- A. Electrical component standard: Components and installation shall comply with CEC, "California Electrical Code."
- B. NEMA compliance: Comply with applicable requirements of NEMA standards pertaining to

conduits and ducts.

- C. UL compliance and labeling: Comply with applicable requirements of UL standards pertaining to electrical ductbank systems. Provide ductbank products and components listed and labeled by UL, ETL, or CSA.
- D. Test Mandrel:
  - 1. Swab and pull mandrel, 1/4" smaller in diameter than the conduit, through the entire length.
  - 2. If any obstructions are encountered, locate and replace the obstructed area. Then retest the duct bank system.

#### 1.8 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500.
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

#### 1.9 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of duct bank prior to excavation for rough-in.
- C. Verify locations of pullboxes, handholes, and manholes prior to excavating for installation.
- D. Duct bank routing is shown on Drawings in approximate locations unless dimensions are indicated. Route as required to complete duct system.
- E. Pullbox, handhole, and manhole locations are shown on Drawings in approximate locations unless dimensions are indicated. Route as required to complete duct system.

### **PART 2 - PRODUCTS**

#### 2.1 MATERIALS

- A. All materials and equipment shall be new and of high quality to give long life and reliable operation. Materials and equipment shall conform to the respective specifications and standards and to the specifications herein.
- B. Manufacturers:

Subject to compliance with requirements, provide products by the following, or equal:

- 1. Metal Conduit and Fittings: Triangle, Pittsburgh, Robroy, Spang, Steel City, NEPCO.



2. Nonmetallic Conduit and Fittings: Carlon, or equal.
- C. Rigid Nonmetallic Conduit: Polyvinyl chloride (PVC) heavy-wall conduit, with tapered sleeve couplings, rated and labeled for use with 90°C rated conductors, manufactured in accordance with ANSI C33.91.
1. Cemented type fittings of the same manufacturer as the conduit.
  2. NEMA TC 2 and UL 651, Schedule 40.
- C. Rigid Metal Conduit: Hot-dipped galvanized steel including the threads, with an outer coating of zinc bichromate, complete with one coupling and one end thread protector, manufactured in accordance with ANSI C80.1 and UL 6.
1. Threaded, hot-dipped galvanized fittings manufactured in accordance with ANSI C80.4.
  2. Where indicated, provide galvanized rigid steel conduit and fittings with polyvinyl chloride (PVC) coating of nominal .020 inch (20 mil ) thickness conforming to NEMA Standard No. RN-1, Type A.
- D. Underground PVC and ABS Plastic Utilities Duct
1. NEMA TC-6, Type I for encased burial in concrete, Type II for direct burial.
- E. PVC and ABS Plastic Utilities Duct Fittings
1. NEMA TC 9-1. Match to duct type and material.
- F. Duct Accessories
1. Types, sizes, and materials complying with manufacturer's published product information. Mate and match accessories with raceway.
- G. Precast Concrete Pullboxes
1. Concrete pullboxes shall be Parkway or Traffic type, as required by location use. Pre-cast in sections with cover marked "Electric" or "Telephone" and with brass hexhead screws. Traffic type shall be constructed for H-20 loading. Acceptable manufacturers: Brooks, Jensen or Quickset.
- H. Precast Concrete Manholes
1. Pre-cast, rectangular, with opening complete with cover. Sizes as indicated on the drawings and, in no case, of less size or material thickness than required by the governing code or utility company requirements. Provide with complete necessary hardware. All ferrous material shall be hot dip galvanized after fabrication. Care shall be exercised in locating boxes to avoid installation in drain water flow areas, and disruption of existing utilities.
  2. Provide precast steel reinforced concrete box complete with all accessories, cable racks and supports, extension rings, pumps, drains, facilities, etc., sized as indicated on drawings. Each section shall have suitable knockouts or openings in vertical walls for all duct banks and conduits entering the assembled structure.
  3. Each casting shall be identified by having the manufacturers' name and address cast into an

interior face or permanently attached thereto. The complete assembly, including frame and cover, shall be rated for AASHTO H-20 Bridge Loading. Submit manufacturer's certificate showing compliance with structural requirements.

- a. All covers shall be rated for supporting motor vehicle traffic.
- b. Provide all covers with appropriate utility system description cast in the cover or by bead weld. Unless otherwise indicated, the inscription shall indicate:

Power: "ELECTRIC"

Communications or Signal: "COMMUNICATIONS" or "SIGNAL"

4. Frames, covers and gratings shall be made of cast iron or galvanized steel. Steel frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel grating shall be of welded galvanized construction and conform to requirements of RR-G-661, Type 1. Provide concrete ring(s) to bring top cover to required elevation. Concrete ring(s) shall be of sufficient height to provide 24" minimum earth cover over the top of box roof, unless otherwise indicated.
5. Pulling irons shall be steel bars bent in a "U" shape, and cast in the walls and floors. In the floor, they shall be centered, and in the wall they shall not be less than 6 inches above or below, and opposite the knockout panels for conduit. Pulling irons shall project into the box approximately 4 inches. Irons shall be hot dip galvanized.
6. Vertical cable racks, including hooks and porcelain insulator cable cradles, shall be sufficient to accommodate the cables.
  - a. The wall bracket shall be channel or T-section steel.
  - b. The hooks shall be of steel or malleable iron and shall be of the removable type.
  - c. The vertical portion of racks shall be hot-dip galvanized steel after fabrication.
  - d. Vertical racks shall be installed on all walls of the manhole a minimum of 18" on center x 60" high. A rack shall be installed within 12" of each corner of each wall. Additional racks spaced equally on each wall shall be installed.
  - e. Wall racks shall be slotted to accept removable hooks and lock hooks into place.
  - f. All fastening hardware, bolts, washers and nuts shall be hot dip galvanized steel.
  - g. Provide 5/8 in. diameter anchor bolts and concrete inserts to support each cable rack.
  - h. Use Underground Devices Inc. No. CR36, RA08, SB1ON cable rack, or equal, hot dipped galvanized, for each box.
  - i. Use Underground Devices Inc. No. CR36, RA08, SB1ON cable hook, or equal, hot dipped galvanized, to mount on each cable rack.
  - j. Use T & B tie rap, self-locking, cable ties No. RV528MX or equal, 2 per insulator, to secure cable to cable hook and cable insulator.
7. Cable Duct Shields: Shields shall be provided where cables enter and leave box, and other duct entrances, and shall be suitable type manufactured for the purpose. All conduits shall have endbells.
8. Provide 8" - 12" diameter sump in the bottom of the box with 18" deep clay tile pipe sump, with cast iron grate.
9. Provide water tight sealing compound between each joint in the sections of the box.
10. The minimum box necking height shall be not less than 24" high with a minimum of two (2) 6-inch high removable necking rings. Provide two galvanized step rungs and ladder rung retainers.

11. Exterior walls and tops of structure shall be damp-proofed on the exterior face with two coats of bituminous damp-proofing.
  12. Provide ground rods in box.
  13. Interior wall shall be painted white in color with concrete paint.
  14. Acceptable manufacturers:
    - a. Brooks Products
    - b. Associated Concrete Products (Quickset)
    - c. Jensen
    - d. Or Equal.
- I. Precast Concrete Handholes
1. Same requirements as precast concrete manholes.
    - a. Size as shown.
- J. Conduit Markers
1. Conduit Markers: ANSI Z35.1 G.2. Pressure-sensitive, adhesive-backed vinyl markers with fade proof ultraviolet inhibitors, black characters on orange background. 2.25" x 9" marker with 1.5" high letters. Marker shall read "(medium voltage potential) VOLTS" – marker voltage label is dependent upon the circuit phase-to-phase voltage. Carlton Industries type EM-1, Seton Code Electrical Markers style AA or approved equal. Provide per utility company requirements.
  2. Provide markers on all exposed conduit for circuits greater than 600 volts. Provide markers at lengths not greater than 20-feet on center.
- K. Warning Tape
1. Underground Warning Tape: The tape shall be 2" wide x .004" polyethelene plastic with metallic core detection tape. The tape shall be of a bright color contrast with soil, with identifying printing on one side. The imprint shall read "Caution (type of utility) Line Buried Below". The identifying lettering shall be repeated continuously the full length of the tape. Seton style 2ELE/2TEL or approved equal.
- L. Moisture Sealing Material
1. Provide a two-part urethane foam sealant which when mixed will expand approximately 15 times in volume to form a dense, strong tough foam unit with density of 3 to 4 pounds per cubic foot. Sealant shall reach 60% full strength in 8 to 10 minutes after application.
- M. Cable Tags
1. Shall be 2" diameter, black anodized aluminum with 3/16" diameter hole. Lettering shall be 5/32" machine engraved and coated with clear lacquer. Include the following information:
    - a. Feeder designation and size.
    - b. Phase designation, tag "A," "B," or "C" as required.
    - c. Manufacturer's name.

- d. System voltage.
- e. Date cable first energized.

### **PART 3 - EXECUTION**

#### **3.1 WIRING METHOD**

A. Wiring Method shall be as follows:

1. Exposed: Rigid steel conduit, unless otherwise indicated.
2. Concealed: Rigid steel conduit, unless otherwise indicated.
  - a. In or under slab on grade: Nonmetallic conduit, Schedule 40 PVC unless otherwise indicated. Conduit leaving the slab (including exposed conduit riser) shall be rigid steel conduit.
3. Underground, single run: Rigid nonmetallic conduit. Use Schedule 40 PVC unless otherwise indicated. Provide concrete encasement as indicated. Conduit leaving the slab (including exposed conduit riser) shall be rigid steel conduit.
4. Underground, grouped: Rigid nonmetallic conduit. Use Schedule 40 PVC unless otherwise indicated. Provide concrete encasement as indicated. Conduit leaving the slab (including exposed conduit riser) shall be rigid steel conduit.

#### **3.2 INSTALLATION**

A. Exercise care in excavating, trenching and working near existing utilities.

Trenching and Backfill:

1. Contractor shall trench underground duct path and manhole location with utmost care in order to avoid existing underground facilities. Trench size shall be kept to a minimum. No oversized trench shall be made unnecessarily.
2. All trench excavations by the Contractor shall be backfilled by same in accordance with this specification.
3. All material excavated during underground electrical work is not pre-qualified for backfill.
4. All fill must be placed in layers not exceeding 8 inches in depth and hand tamped or machine compacted to at least 95 percent of its maximum dry density as computed by the ASTM method of performing a compaction test (D-1557-70).
5. All compacted fill will be under continuous inspection by the Inspector. Compaction tests will be arranged for by the Inspector in cooperation with the Contractor.
6. Puddling or water-flooding for settling backfill will not be permitted except in landscaped areas. The addition of water shall be limited to achieving optimum moisture content for tamp procedures.
7. Where Contractor trenches crosses any finished road (paved or gravel), he shall be responsible for restoring the road to its original condition. Repaving shall be with the same surrounding material and to a quality equal or exceeding its surround.

8. Do not backfill for a period of at least 24 hours after pouring concrete. Upon receipt of the Inspector's approval proceed with backfill. Backfill with 1 sack slump concrete and repair of surface to be completed within 24 hours of approval. Provide wet sand backfill in landscape areas.
9. Survey slope of trenches and ducts between terminations to provide drainage. No pockets shall be permitted.

B. Underground Duct with Concrete Encasement:

1. Underground ductbanks lines shall be constructed of individual conduits encased in concrete. Conduit shall be of Schedule 40 PVC. The kind of conduit used shall not be mixed in any one duct bank. PVC ducts shall not be smaller than 2 inches in diameter unless otherwise indicated. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete outer encasement for ducts. Conduit shall be separated by a minimum concrete thickness of 2 inches.
2. The top of the concrete envelope shall not be less than 36 inches below grade, except that under roads and pavement it shall be not less than 36 inches below grade.
3. Ductbanks shall have a continuous slope downward toward manholes with a pitch of not less than 1.5 inches in 100 feet. Except at conduit risers, changes in direction of runs exceeding a total of 10 degrees, either vertically or horizontally, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 24 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 48 inches for ducts of 3 inches in diameter and larger.
4. PVC conduits shall terminate in end-bells where duct lines enter pullboxes or manholes. Separators shall be of precast concrete, high-impact polystyrene, steel, or any combination of these. The joints of the conduits shall be staggered by rows and layers so as to provide a duct line having maximum strength.
5. During construction, partially completed duct lines shall be protected from the entrance of debris such as mud, sand, concrete and dirt by means of suitable conduit. As each section of a duct line is completed, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the size of the conduit shall be drawn through each conduit, after which a brush having the diameter of the duct and having stiff bristles shall be drawn through the conduit until it is clear of all particles of earth, sand, or gravel. Conduit plugs shall then be immediately installed.
6. Locate spacers no greater than 5 ft. center to center, along entire length of ductbank.
7. Duct couplings may be placed side by side horizontally, but staggered at least 6 in. vertically.
8. Make conduit joints in accordance with manufacturer's recommendations. In the absence of specific recommendations, make the joints as follows:
  - a. Brush a plastic solvent cement on the inside of the coupling and on the outside of the duct ends.
  - b. Slip duct and fitting together with a quick one-quarter turn to set the joints.
9. Follow ductbank sections on the drawings for size, arrangement and spacing of ducts.

10. Secure ducts and spacers to prevent movement during placement of concrete.
11. At connection to existing manhole, dowel the concrete encasement with one #4 reinforcing bar 36 in. long per duct. (Minimum of two required.)
12. Concrete; in accordance with requirements of utility company requirements and the following:
  - a. Provide #4 rebar dowels at each concrete joint/pour transition. A minimum of 8' long #4 rebar dowel, one (1) per conduit in ductbank.
  - b. Provide rebar and tie-downs to prevent conduits from floating to top of concrete during curing.
  - c. Make ductbank construction monolithic top to bottom and side to side.
  - d. Do not exceed the outside dimension of the completed ductbank by more than 1 inch in the vertical or 4 inches in the horizontal from dimensions indicated.
  - e. Use plastic film to retain moisture for proper curing.
13. Ductbank concrete may be poured without forming, provided trench walls are firm and will not cave in during installation. Unless noted otherwise, encase the raceway on all sides with a minimum of 3 inches of concrete.
14. Where conduits are stubbed out for future connection, stop concrete 12 inches from end of conduit. Provide a waterproof cap on the end of the conduit.
15. The top of the concrete ductbank shall be as shown on the drawings, or as otherwise required by code and as required to coordinate with other underground obstructions.

#### C. Connections to Existing Ducts

1. Where connections to existing duct lines are indicated, excavate the lines to the maximum depth necessary. Cut off the lines and remove loose concrete from the conduits before installing new concrete encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines. Remove existing cables which constitute interference with the work.

#### D. Connections to New Handholes and Manholes

1. Construct concrete-encased duct lines connecting to underground structures to have a flared section adjacent to the handhole or manhole to provide shear strength. Construct underground structures to provide for keying the concrete encasement of the duct line into the wall of the structure. Use vibrators when this portion of the encasement is poured to ensure a seal between the encasement and the wall of the structure.

#### E. Connection to Existing Handholes and Manholes

1. For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and band out to tie into the reinforcing of the duct line encasement. Chip out the structure wall to form a key for the duct line encasement.

#### F. Connections to Existing Concrete Pads

1. For duct line connections to concrete pads break an opening in the pad out to the dimensions required and preserve steel in pad. Cut the steel and bend out to tie into the reinforcing of the

duct line encasement. Chip out the opening in the pad to form a key for the duct line encasement.

G. Removal of Ducts

1. Where duct lines are removed from existing manholes, close openings and waterproof manhole. Chip out the wall opening to provide a key for the new section of wall.

H. Precast manholes, handholes, and pullboxes shall be of sizes required.

1. Manholes and handholes:

- a. Precast concrete assembly shall be set on 6 inches of level, 95 percent compacted, crushed rock fill, 3/4" to 1" size, extending 12" beyond the manhole on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator. Drain line and accessories shall be installed as indicated.
- b. Excavate, backfill, and compact in accordance with requirements of Division 2. Utilize dirt removed to level and restore landscape a minimum of 6 feet around box.
- c. Seal section joints with sealing compound furnished by the manufacturer.
- d. Apply two coats of asphalt paint to cover frames.
- e. Provide two 3/4" diameter x 10" long copper-clad driven ground rods at opposite corners of manholes and handholes with #2/0 AWG bare copper ground wire interconnecting all non-current carrying metal components in manhole or handhole with compression type ground fittings at each connection point.
- f. Ground all cable racks, supports, metal conduits and ductbank grounding conductors to the driven grounding electrode.
- g. Restore landscape to original condition.
- h. Place duct and conduit entries not less than 24" above floor. Provide end bells at all duct entrances. Terminate each metal conduit with insulated bushing having grounding terminal.
- i. Place pulling irons on opposite walls and below horizontal centerlines of duct openings, and in bottom directly below cover. Install pulling irons with each end hooked around a reinforcing bar.
- j. Dampproof exterior walls and tops of structure below grade with two coats of bituminous coating. Use A.C. Horn Company "Dehydratine" No. 4, Sonneborn Sons, Inc. "Hydrocide 648," Toch Brothers "RIW Marine Cement Semi-Mastic," or equal.
- k. Identify all power and signal cables by tagging in all man holes. Tie securely to cables with nylon cord.
- l. Install cables in conformance with NEC requirements.

3.3 PREPARATION FOR PULLING IN CONDUCTORS

- A. Do not install crushed or deformed raceways or conduits. Avoid traps in raceways where possible. Take care to prevent the lodging of concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pulling wires.
- B. Immediately after installation, plug or cap all raceway ends with water-tight and dust-tight seals until the time for pulling conductors.
- C. For all new concrete-encased raceways, after the concrete envelope has set, pull a mandrel of a diameter approximately 1/4-inch less than the raceway inside diameter, through each raceway. Then pull a bristly brush through each raceway to remove debris.

- D. For existing underground raceways, pull a mandrel of a diameter approximately 1/4-inch less than the raceway inside diameter, through each raceway. Then pull a bristle brush through each raceway to remove debris.

### 3.4 EMPTY RACEWAYS

- A. Certain raceways will have no conductors pulled in as part of the Contract. Identify with melamine plastic tags at each end and at any intermediate pull point the origin and destination of each such empty raceway. Where a raceway has been identified with a name (number) in the Feeder Schedule, use that name on the tag in lieu of origin and destination. Provide a removable permanent cap over each end of each empty raceway. Provide a 3/8" nylon (or larger where required) pull cord in each empty raceway.
- B. Rod clean and provide pull rope in all existing ducts to be used for conductor paths under this contract.

END OF SECTION



**SECTION 26 05 48**  
**VIBRATION AND SEISMIC CONTROLS 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. Channel support systems.
  - 2. Restraint cables.
  - 3. Hanger rod stiffeners.
- B. Related Sections include the following:
  - 1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Perform calculations to obtain force information necessary to properly select seismic restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASC/SEI 7-16. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to in this subparagraph is the edition intended as reference throughout the Section Text.
  - 1. Data indicated below to be determined by Delegated-Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
  - 2. Coordinate Seismic design calculations with wind-load calculations for equipment mounted outdoors. Comply with requirements in other Sections in addition to those in this Section for Equipment mounted outdoors.

3. Coordination with seismic and wind loading design parameters with the structural documents.
- B. Calculation Factors, ASCE/SEI 7-16, Chapter 13 – Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-16 unless otherwise noted from, the project structural drawings.
1. Horizontal Seismic Design Force  $F_p$ : Value is to be calculated by Delegated-Design Contractor using Equation 13.3-1. Factors below must be obtained for this calculation:
    - a.  $S_d$  = Spectral Acceleration: See Structural Drawings. Value applies to all components on project.
    - b.  $A_p$  = Component Amplification Factor: See Structural Drawings.
    - c.  $I_p$  = Component Importance Factor: See Structural Drawings
    - d.  $W_p$  = Component Operating Weight: For each component. Obtain by Delegated-Design Contractor from each component submittal.
    - e.  $R_p$  = Component Response Modification Factor: See drawing structural schedule.
    - f.  $z$  = Height in Structure of Point of Attachment of Component for Base: Determine from Project Drawings for each component by Delegated-Design Contractor. For items or below the base, “ $z$ ” shall be taken as zero.
    - g.  $h$  = Average Roof Height of Structure for Base: Determine from Project Drawings by Delegated-Design Contractor.
  2. Vertical Seismic Design Force: Calculated by Delegated-Design Contractor using method explained ASCE/SEI 7-16, Paragraph 13.3.1.2.
  3. Seismic Relative Displacement  $D_{pl}$ : Calculate by Delegated-Design Contractor using methods explained in ASCE/SEI 7-10, Paragraph 13.3.2. Factors below must be obtained for this calculation:
    - a.  $D_p$  = Relative Seismic Displacement that each component must be designed to accommodate: Calculate by Delegated-Design Contractor in Accordance with ASCE/SEI 7-10, Paragraph 13.3.2.
    - b.  $I_e$  = Structure Importance Factor: See structural drawing. Value applies to all components on Project.
    - c.  $\delta_{xA}$  = Deflection at Building Level  $x$  of Structure A. See Structural Drawing.
    - d.  $\delta_{yA}$  = Deflection at Building Level  $y$  of Structure A. See Structural Drawing.
    - e.  $\delta_{yB}$  = Deflection at Building Level  $y$  of Structure B. See Structural Drawing.
    - f.  $h_x$  = Height of Level  $x$  to which upper connection point is attached: Determine for each component Delegated-Design Contractor from Project Drawings and manufacturer’s data.
    - g.  $\Delta a_A$  = Allowable Story Drift for Structure A: See Structural Drawing.
    - h.  $\Delta a_B$  = Allowable Story Drift for Structure B: See Structural Drawing.
    - i.  $h_{sx}$  = Story Height used in the definition of allowable drift  $\Delta a$ : See Structural Drawings.
  4. Component Fundamental Period  $T_p$ : Calculated by Delegated-Design

Contractor using methods explained in ASCE/SEI 7-16, Paragraph 13.3.3. Factors below must be obtained for this calculation:

- a.  $W_p$  = Component Operating Weight: Determined by Contractor from project drawings and manufacturer's data.
- b.  $g$  = Gravitational Acceleration: 32.17  $\text{fps}^2$ .
- c.  $K_p$  = Combined stiffness of component, supports and attachments: Determined by Delegated-Design seismic Engineer.

## 1.5 SUBMITTALS

### A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. 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 agency acceptable to authorities having jurisdiction.
  - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

### B. 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 forces required to select vibration isolators and seismic restraints.
  - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:
  - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
  - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the

structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.

- c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For professional engineer and testing agency.
- F. Field quality-control test reports.

## 1.6 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. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. California Dynamics Corporation.
  - 2. Cooper B-Line, Inc.; a division of Cooper Industries.
  - 3. Unistrut; Tyco International, Ltd.

- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements 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 four times the maximum seismic forces to which they will be subjected.
- C. 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.
- D. Restraint Cables: ASTM A 603 galvanized -steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. 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.
- G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- H. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

## 2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- 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 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
  - 1. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. 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.
- C. 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.

### 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  3. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  4. Test to 90 percent of rated proof load of device.
  5. Measure isolator restraint clearance.
  6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Adjust isolators after isolated equipment 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 active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

### 3.7 ELECTRICAL VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

- A. Supported or Suspended Equipment:
1. Pads:
    - a. Material: Neoprene.
  2. Component Importance Factor: 1.5.
  3. Component Response Modification Factor: 5.0.
  4. Component Amplification Factor: 2.5.

**END OF SECTION**





**SECTION 26 05 53**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes:
  - 1. Identification labeling for raceways, cables, and conductors.
  - 2. Warning and caution signs
  - 3. Operational instruction signs.
- B. Electrical identification requirements in this Section may be supplemented in other sections of these specifications.
- C. Related Sections:
  - 1. General electrical requirements: Section 260500.
  - 2. Color coding of conductors for phase identification: Section 260519.
  - 3. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.
- B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:
  - 1. ANSI American National Standards Institute.
  - 2. ASTM American Society for Testing and Materials.
  - 3. IEEE Institute of Electrical and Electronics Engineers.
  - 4. CECCalifornia Electrical Code (NFPA 70).
  - 5. NEMA National Electrical Manufacturers Association.
  - 6. NFPA National Fire Protection Association
  - 7. UL Underwriters Laboratories, Inc.

1.3 SUBMITTALS

- A. In addition to this Section, the submittal requirements of Section 26 05 00.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose

specified and shown.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual labeling and identification of electrical equipment, components, and wiring.

#### 1.6 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "California Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 26 05 00.
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

#### 1.8 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by the following:

Brady  
Ideal Industries  
Markal  
Panduit  
Thomas & Betts

#### 2.2 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Adhesive Marking Labels for Raceway and Metal-clad Cable: Pre- printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Power, Lighting, Air Conditioning, Voice and Data Communications, Control, Fire Alarm and Detection, Public Address (Paging), Electronic Security).
- B. Label Size, as follows:
  - 1. Raceways 1-Inch and Smaller: 1-1/8 inches high by 4 inches long.
  - 2. Raceways Larger than 1-Inch: 1-1/8 inches high by 8 inches long.

- C. Color: Black legend on orange background.
- D. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.
- E. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Raceway and Cable Identification: Flexible acrylic bands sized to suit the raceway diameter and arranged to stay in place by pretensioned gripping action when coiled around the raceway or cable.
- F. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with Preprinted numbers and letter.
- G. Aluminum, Wraparound, Cable Marker Bands: Bands cut from 0.014-inch thick, aluminum sheet, fitted with slots or ears for securing permanently around wire or cable jacket or around groups of conductors. Provide for legend application with stamped letters or numbers.
- H. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field-printed legends to suit the application. Orange background, except as otherwise indicated, with eyelet for fastener.
- I. Aluminum-Faced Card Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inches thick, and laminated with moisture-resistant acrylic adhesive. Pre-print legend to suit the application, and punch for tie fastener.
- J. Brass or Aluminum Tags: Metal tags with tamped legend, punched for fastener. Dimensions: 2 inches by 2 inches by 19 gauge.
- K. Engraved, plastic-laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letter on black face and punched for mechanical fasteners.
- L. Warning and caution signs for indoor use: Shall be minimum 18 gauge steel, white porcelain enamel finish, with red lettering, punched for fasteners, with colors, legend, and size appropriate to the location. Lettering to read, "DANGER - HIGH VOLTAGE - KEEP OUT," unless otherwise indicated.
- M. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, nonfading, preprinted cellulose acetate butyrate signs with 20-gauge, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.
- N. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.
- O. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color coding.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General:
  - 1. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.
  - 2. Install identification devices in accordance with manufacturer's written instructions and requirements of CEC.
  - 3. Sequence of Work: Where identification is to be applied to surfaces that require finish, install

identification after completion of finish work.

B. Identify electrical equipment and enclosures, including but not limited to the following:

1. General

- a. Pull-, junction-, and splice-boxes
- b. Terminal boxes and cabinets
- c. Access doors and panels for concealed electrical items

D. Identify electrical circuits:

E. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuit. Use pressure-sensitive plastic labels at exposed location and similar labels or plasticized card stock tags at concealed boxes.

F. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductor throughout the project secondary electrical system as follows:

<u>208/120 Volts</u>	<u>Phase</u>	<u>480/277 Volts</u>
Black	A	Yellow
Red	B	Brown
Blue	C	Orange
White	Neutral	White
Green	Ground	Green

G. Use conductors with color factory-applied the entire length of the conductors except as follow:

- 1. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
  - a. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two lap of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
  - b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and paced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

H. Power Circuit Identification: Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders, and power circuit in vault, pull boxes, junction boxes, manhole, and switchboard rooms with 1/4-inch steel letter and number tamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-lb test monofilament line or one-piece self-locking nylon cable ties.

I. Tag or label conductors as follows:

- 1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
- 2. Multiple Circuits: Where multiple branch circuits or control wiring or communications / signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home run) label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by

means of coded color of conductor insulation. For control and communication / signal wiring, use color coding or wire / cable marking tape at termination and at intermediate location where conductors appear in wiring boxes, troughs, and control cabinet. Use consistent letter / number conductor designation throughout on wire / cable marking tape.

3. Match identification markings with designations used in panelboards, shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installation.
- J. Apply warning, caution, and instruction signs and stencils as follows:
1. Install warning, caution, or instruction signs where required by CEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic laminated instruction signs with approved legend where instruction or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
    - a. In addition to the above:
      - 1) Warning signs shall be included on door, or immediately above door, of all electrical equipment rooms, or closets containing equipment energized above 150 volts to ground.
      - 2) Warning designations in 1-inch high red letters shall be painted by stencil, or applied with pre-printed adhesive labels, on each pullbox, cabinet, or 10-foot length of exposed raceway stating: "DANGER-KEEP OUT", and stating the voltage of the enclosed conductors (for example, "480 VOLTS"), for all systems of over 150 volts to ground.
    2. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instruction on power transfer, load shedding, or other emergency operations.
    3. Permanently mount signs with cadmium plated steel screws or nickel-plated brass bolts.
- K. Install equipment/system circuit/device identification as follows:
1. Apply equipment identification labels of engraved plastic-laminate (fastened with self-tapping or threaded screws) on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with a minimum of 1/4-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), white lettering in black field. Adhesive letters are not acceptable. Text shall match terminology and numbering shown, if provided. For emergency systems, the background field shall be red and include the word, "EMERGENCY." Apply label for each unit of the following categories of electrical equipment:
    - a. Access doors and panels for concealed electrical items.
- L. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm / signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.
- M. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

## END OF SECTION



## SECTION 26 24 13 SWITCHBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section Includes:

1. Distribution switchboards, front-accessible, indoor-type, rated 600 volts and below.

B. Related Sections:

1. Grounding and bonding: Section 260526.
2. Supporting devices: Section 260529.
3. Electrical identification: Section 260553.
4. Panelboards: Section 262416.

#### 1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General- and Supplementary-Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. American National Standards Institute

ANSI C12 Code for Electricity Metering  
ANSI C39.1 Electrical Analog Indicating Instruments  
ANSI C57.13 Requirements for Instrument Transformers

2. ASTM American Society for Testing and Materials

3. IEEE Institute of Electrical and Electronics Engineers

4. CEC California Electrical Code (NFPA 70)

5. NECA National Electrical Contractors Association "Standard of Installation"

6. NEMA National Electrical Manufacturers Association

NEMA AB 1 Molded Case Circuit Breakers  
NEMA KS 1 Enclosed and Miscellaneous Equipment Switches (600 Volts Maximum)  
NEMA PB 2 Dead Front Distribution Switchboards  
NEMA PB 2.1 General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less  
NEMA 260 Safety Labels for Padmounted Switchgear and Transformers Sited in Public Areas

7. NFPA National Fire Protection Association

8. Underwriters Laboratories, Inc.

UL 486A Wire Connectors and Wiring Lugs for Use with Copper Conductors  
UL 486B Wire Connectors for Use with Aluminum Conductors  
UL 891 Deadfront Electrical Switchboards

### 1.3 SUBMITTALS

- A. General: Submit the following in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500, "General Electrical Requirements."
- B. Shop Drawings: Include layouts showing cabinet dimensions, conduit entrances, electrical ratings, bussing connections, single line diagrams, device locations and ratings, and cable termination provisions.
- C. Product Data: Submit for each type of product specified.
- D. Operating, Maintenance, and Instructional Data: Manufacturers' written operating, maintenance, and installation instructions, including directions for storage and protection, handling, examination, and preparation.
  - 1. In addition, include copies of this data in Operating and Maintenance Manuals submitted, see Section 260500.
- E. Samples: Provide samples upon specific request.
- F. Certificates:
  - 1. Labels of UL listing, fixed to each item of material.
    - a. Label of UL listing for service entrance use, where applicable, affixed to material.

### 1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "California Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.



## 1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

## 1.7 EXTRA MATERIALS

- A. Furnish 3 of each type and size of fuse installed.

## **PART 2 - PRODUCTS**

### 2.1 ACCEPTABLE MANUFACTURERS

- A. General Electric
- B. Square D
- C. Cutler-Hammer

NOTE: All equipment installed and submitted on this project must have an OSHPD OSP Listing.

### 2.2 MATERIALS

- A. Main Switchboard:
  - 1. Furnish and install a totally enclosed, dead front, safety type switchboard designed for voltage and service ampacity as indicated on drawings and mounted on 6" thick concrete pad.
- B. Provide a switchboard consisting of the required number of vertical sections bolted together to form one metal enclosed, rigid switchboard with the following features:
  - 1. The sides, top and rear covered with removable screw-on code gauge steel plates.
  - 2. Include all protective devices and equipment as listed on drawings with necessary interconnections.
  - 3. Silver or tin plated copper bus.
  - 4. Bus bars mounted on supports of high impact nontracking insulation material braced to withstand mechanical forces exerted during 100,000 amp RMS symmetrical short circuit conditions, or as required by serving utility.
- C. Chemically clean steel surfaces and treat to aid bonding between paint and metal surfaces. Provide high tensile strength hardware on conductors and suitable protective finish.
- D. Provide full length copper ground bus. Secure a ground bus to each vertical section of structures and extend it the entire length of the switchboard.
- E. Provide switchboard with adequate lifting means, capable of being rolled or moved into installation position and bolted directly to the floor without the use of floor sills.
- F. Use A-B-C type bus arrangement - left-to-right, top-to-bottom and front-to-rear throughout. Switchboard shall be entirely accessible from the front, including cable and bus connections, unless specifically noted otherwise.
- G. Provide group mounted, quick-break protective devices with bar connection straps, with device

line and load connections accessible from the front. Where "spaces" are scheduled furnish entire bus except device connecting straps. Provide full height wiring gutter covers for quick access to wiring terminals.

- H. The switchboard frame work shall be made of formed steel angles securely bolted or riveted together. Adjacent to each switch unit provide a lamacoid plastic name plate engraved with proper circuit designation, screw-on type only.
- I. At top of switchboard and supported on the frame, there shall be provided a pull box for termination of the conduits to the board. It shall not be less than 18" in height and shall be built as an integral part of the switchboard. The front of the pull box shall be removable and the bottom shall consist of ebonized asbestos panels drilled for cables and bussing. The entire exterior of the switchboard and pull box enclosures shall be painted with prime coat and finished smooth with 2 coats of gray enamel, ASA 33.
- J. Switches over 600 ampere capacity shall be bolted pressure contact type of capacity and number of poles indicated and equipped with Bussmann Hi-Cap, current limiting fuses only.
- K. Switches 600 ampere and below shall be quick-make, quick-break of capacity and number of poles indicated.
- L. Switches 600 amperes and below shall be equipped with rejection type fuse clips to accept only high capacity type fuses. Furnish current limiting type fuses.
- M. Main busses shall be silver or tin plated copper sized on the basis of a current density to hold temperature rise to 50 degrees C above 40 degrees C ambient. The bus structure shall be braced to withstand the mechanical forces exerted during a fault as shown on the drawings.
- N. The switchboard shall bear the label of approval of the Underwriter's Laboratories and shall be built to NEMA and IEEE standards. Seven copies of shop drawings of the proposed board shall be furnished to comply with these specifications.
- O. Circuit breakers:
  - 1. Resettable, quick-make, quick-break, bolt-in place type, trip-free, with separate trip position from on and of positions.
  - 2. Multiple pole breakers with common trip and one operation handle.
  - 3. Do not provide handle ties.
  - 4. Wire with sequence phasing.
- P. Furnish record drawings providing the following information;
  - 1. Complete rating.
  - 2. Short circuit withstand-ability of bus and Lowest rated device.
  - 3. Overall outline dimensions including space available for conduits.
  - 4. Circuit schedule showing circuit number
  - 5. Device description
  - 6. Feeder circuit identification

7. Conductor ratings and one-line diagram with each circuit device numbered.
- Q. Provide switchboards meeting U.L. Standard #UL891 and NEMA Standard PB-2. The U.L. label shall appear on all switchboard sections which contain U.L. listed devices.
- R. Provide ground fault protection on each main devices, rated 480/277 ground wye, 1000 amps or larger, as follows:
  1. U.L. listed ground sensor relay system equal to General Electric GSR. Provide ground break components for each system with coordinated ground sensor (CR) and integral test winding. Provide with solid state relay to operate shunt trip circuit on the switch and monitor panel.
  2. Use time relay with the following features:
    - a. Continuously adjustable current pick-up settings of 100 to 1200 amperes.
    - b. Continuously adjustable time delay setting from instantaneous (.03 seconds) to one second.
    - c. Memory function to recognize and initiate tripping on intermittent ground faults.
  3. Install panel which:
    - a. Indicates relay operation.
    - b. Provides means for testing the system with or without interruption of electrical service.
    - c. Does not permit the ground fault system to be inadvertently left in an inactive or "off" state.
  4. Use ground sensor for zero sequence arrangement on the main service entrance devices.
- S. Provisions for padlocking the circuit breakers or disconnect in the "on" and "off" positions.
- T. Provide full rated bussing (no cascading).

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Carefully measure and lay out exact locations of switchboards in conference with Owner.
- B. Assure that panelboards may be installed without adversely affecting the integrity and appearance of the building structure and with the clearances required by the California Electrical Code.

#### **3.2 INSTALLATION**

- A. Install switchboard sections plumb and in straight horizontal alignment, securely fasten to one another, and anchor to floor slab with adequate concrete inserts and 5/8-inch bolts.
- B. Install distribution switchboards on concrete foundations in accordance with other sections of the specifications.
- C. Terminate service and feeder conduits only in the switchboard section containing the lugs or device to which they are to be connected.
- D. Provide switchboards of the types and ratings scheduled where indicated.

- E. Provide supports to the building structure, independent of raceways.
- F. Install switchboards so that highest disconnecting breaker or switch handle is at a maximum of 6 feet 6 inches above finished floor.
- G. Provide identification:
  - 1. For switchboard circuits: Engraved, lamacoid plastic nameplate, white with black letters, giving circuit numbers and equipment identification.
  - 2. All nameplates to be stainless steel screw-on types, no cement.
- H. The anchorage of motor and circuit disconnects required for elevator drives, emergency generator, emergency motor loads, fire pumps and emergency lighting shall be designed in accordance with Section 2312 of the Uniform Building Code for a lateral force based on a "Cp" value.

### 3.3 FIELD QUALITY CONTROL

- A. Perform manufacturer's recommended field test prior to energization.
- B. Provide copies of test results to Owner.

### 3.4 LABELING AND IDENTIFICATION

- A. Provide engraved plastic nameplates on all switchboards not shown as exiting on the single line diagram, unless otherwise noted.
- B. Provide equipment and circuit designation on nameplates with minimum letter and plate sizes as indicated.
- C. Provide engraved plastic nameplates with 1/4-inch minimum height letters indicating circuit designation at branch overcurrent devices in switchboards.
- D. Secure nameplates with at least two screws or rivets. Cementing and adhesive installation not acceptable.

END OF SECTION

**SECTION 26 24 16  
PANELBOARDS**

**PART 1 - GENERAL**

1.1 SUMMARY

A. This Section Includes:

1. Branch circuit and distribution panelboards, both circuit breaker- and fused switch-type, rated 600 volts and below.

B. Related Sections:

1. Grounding and bonding: Section 260526.
2. Supporting devices: Section 260529.
3. Electrical identification: Section 260553.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General- and Supplementary-Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. ANSI American National Standards Institute
2. ASTM American Society for Testing and Materials
3. IEEE Institute of Electrical and Electronics Engineers
4. CEC California Electrical Code (CEC)
5. NECA National Electrical Contractors Association "Standard of Installation"
6. NEMA National Electrical Manufacturers Association
  - NEMA AB 1 Molded Case Circuit Breakers
  - NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies
  - NEMA PB 1 Panelboards
  - NEMA PB 1.1 Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
7. NFPA National Fire Protection Association
8. Underwriters Laboratories, Inc.
  - UL 50 Cabinets and Boxes
  - UL 67 Panelboards

### 1.3 SUBMITTALS

- A. General: Submit the following in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500.
- B. Shop Drawings: Include layouts showing cabinet dimensions, conduit entrances, electrical ratings, bussing connections, single line diagrams, device locations and ratings, and cable termination provisions.
- C. Product Data: Submit for each type of product specified.
- D. Operating, Maintenance, and Instructional Data: Manufacturers' written operating, maintenance, and installation instructions, including directions for storage and protection, handling, examination, and preparation.
  - 1. In addition, include copies of this data in Operating and Maintenance Manuals submitted, see Section 260500.
- E. Samples: Provide samples upon specific request.
- F. Certificates:
  - 1. Labels of UL listing, fixed to each item of material.
    - a. Label of UL listing for service entrance use, where applicable, affixed to material.

### 1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "California Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500, "General Electrical Requirements."
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

### 1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Siemens
- B. General Electric
- C. Square D
- D. Cutler-Hammer

NOTE: All equipment installed and submitted on this project must have an OSHPD OSP Listing.

### 2.2 MATERIALS

#### A. Branch circuit panelboards:

1. Provide factory assembled, enclosed panelboards in dead front cabinets, with doors, surfaced mounted or recessed as indicated, not less than 20" wide and 5-3/4" deep. Height will depend on the number of breakers and spaces.
2. Where a control compartment is indicated, provide an integral compartment with a separate hinged lockable door held with captive screws.
3. Provide feeder terminal lugs for both main lugs only and main breakers rated for use with copper or aluminum conductors.
4. Provide three phase, 4 wire, solid neutral design with sequence bussing, full capacity neutral and full length copper bussing including areas indicated as space only. Bussing shall be braced for maximum available fault.
5. Provide copper neutral bus where neutral bus is indicated. Neutral bus shall be sized for minimum twice the current carrying capacity of line bus.
6. Key all door locks alike. Provide a type written directory of circuit index card holder mounted behind the door in framed card slot with plastic see through window.
7. Provide full size copper equipment ground bus.
8. All breakers shall be bolt-on type molded case. No tie handle is accepted for multi-pole breaker.
9. Provide pad lock off devices on all breakers serving appliances, motor operated equipment, HVAC equipment and other circuit as indicated on panel schedules.
10. 120/208V, 3 Phase, 4 Wire Panelboards: General Electric Co. type NLAB, Square D Co. type NQOB, or Cutler-Hammer type POW-R-LINE1.
11. 277/480V, 3 Phase, 4 Wire Panelboards: General Electric Co. type NHB, Square D Co. type NEHB, ITE, Inc. type NHB, Sylvania Co. type NH1B or Cutler-Hammer type POW-R-LINE2.
12. All equipment shall be listed to meet or exceed the available fault current indicated on drawings.

13. Provide main lugs only unless scheduled otherwise.
14. Construct in accordance with U.L. and NEMA Standards.

B. Distribution Panelboards:

1. Provide circuit breaker type distribution panelboards with fully rated copper bus, lockable molded case breakers for mains and feeders. Provide nameplates for all circuit breakers.
2. Busing shall be braced to withstand maximum available fault current indicated on drawings.
3. Provide copper neutral bus where indicated. Neutral bus shall be sized for minimum twice the current carrying capacity of line bus.
4. Provide full size copper ground bus adequate for number of grounded circuits.
5. General Electric Co. type NCP and type CCB, or Square D Co. types HCN and HCM, or Cutler-Hammer type POW-R-LINE3 and POW-R-LINE4B.

C. Circuit breakers:

1. In accordance with section 260573.
2. Resettable, quick-make, quick-break, bolt-in place type, trip-free, with separate trip position from on and off positions.
3. Multiple pole breakers with common trip and one operation handle.
4. Do not provide handle ties.
5. Wire with sequence phasing.
6. Circuit breakers shall be rated to meet or exceed the available fault current indicated on drawings.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Carefully measure and lay out exact locations of panelboards in conference with Owner.
- B. Assure that panelboards may be installed without adversely affecting the integrity and appearance of the building structure and with the clearances required by the California Electrical Code.

#### **3.2 INSTALLATION**

- A. Provide panelboards of the types and ratings scheduled where indicated.
- B. Provide flush or surface mounted types where indicated and scheduled.
  1. Provide multi-section cabinets as required and scheduled.
  2. Provide 2 keys for each panelboard.



- C. Provide supports to the building structure, independent of raceways.
- D. Install tops of cabinets at 6 feet 6 inches above finished floor.
- E. Install panelboards in cabinets, centered in door openings.
- F. Secure panelboards to building structure to withstand wire pulling strains.
- G. Secure surface mounted panelboards to wood studs or channel material spanning metal studs.
- H. Do not use toggle bolts.
- I. Provide identification:
  - 1. For panelboards: Engraved, lamacoid plastic nameplate, white with black letters, giving panelboard designation, voltage, phase, wire and ampacity.
  - 2. For branch circuit panelboards: Neatly typewritten circuit directory in cardholder inside panelboard door. Identify rooms served using room numbers corresponding to those finally established at the project.
  - 3. All nameplates to be stainless steel screw on types, no cement.

### 3.3 FIELD QUALITY CONTROL

- A. Perform manufacturer's recommended field test prior to energization.
- B. Provide copies of test results to Owner.

END OF SECTION



**SECTION 26 27 26**  
**WIRING DEVICES**

**PART 1 - GENERAL**

1.1 SUMMARY

A. This Section includes:

1. Receptacles.
2. Snap Switches.
3. Wall Plates.
4. Floor Service Outlets.

B. Related Sections:

1. General electrical requirements: Section 260500.
2. Wire and cable: Section 260519.
3. Grounding and bonding: Section 260526.
4. Supporting devices: Section 260529.
5. Electrical identification: Section 260553.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. ANSI American National Standards Institute
2. ASTM American Society for Testing and Materials
3. IEEE Institute of Electrical and Electronics Engineers
4. CECCalifornia Electrical Code (CEC)
5. NECA National Electrical Contractors Association: "Standard of Installation"
6. NEMA National Electrical Manufacturers Association
7. NFPA National Fire Protection Association
8. Underwriters Laboratories, Inc.

- UL 20 General Use Snap Switches
- UL 94.3 UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
- UL 486A Wire Connectors and Wiring Lugs for Use with Copper Conductors
- UL 498 Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- UL 1010 Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
- WD 1 General Requirements for Wiring Devices
- WD 6 Wiring Device-Dimensional Requirements

### 1.3 SUBMITTALS

- A. General: Submit the following in accordance with the Conditions of the Contract and Division 1 Specification Sections, and Section 260500.
- B. Product Data: Submit for each type of product specified.
- C. Installation instructions: Manufacturer's written installation instructions for wiring devices. Include instructions for storage, handling, protection, examination, and preparation of Product.
- D. Samples: Provide samples under specific request.

### 1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with CEC, "California Electrical Code".
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500.
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

### 1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by the following:

Hubbell  
 Pass and Seymour  
 Square D  
 Leviton

2.2 WIRING DEVICES

- A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Verify color of all device plates with Project Architect or Interior Designer prior to placing order.
- B. Receptacles: UL 498 and NEMA WD 6. Straight blade, two-pole, three-wire grounding type, except as otherwise indicated below:

RECEPTACLES: RATINGS AND TYPES [1]					
OUTLET TYPE	CURRENT RATING	VOLTAGE RATING	NEMA CONFIGURATION	UL GRADE	MANUFACTURER [5]
Duplex	20 A	125 V	5-20R	Heavy Duty	Hubbell 5362
Duplex, GFI [2]	20 A	125 V	5-20R	Heavy Duty w/Integral GFI	Hubbell GF5362
Single	20 A	125 V	5-20R	Heavy Duty	Hubbell 5361
Single	20 A	250 V	6-20R	Heavy Duty	Hubbell 5461
Single, Locking [3]	20 A	125 V	L5-20R	Heavy Duty	Hubbell 2310
Single, Locking [3]	20 A	250 V	L6-20R	Heavy Duty	Hubbell 2320
Pin and Sleeve [4]	As Required	As Required	Not Applicable	498-General; 1010-Classified Locations	Hubbell
Notes: 1. Except as otherwise indicated. 2. GFI receptacles shall protect downstream receptacles on same circuit, where indicated on plans. 3. Provide locking receptacles with black nylon face, except as otherwise indicated. 4. Provide features indicated. 5. Verify color selection with Architect/Engineer. (As listed, each catalog number specifically indicates the color of the device - revision may be required.)					

2.3 WIRING DEVICE ACCESSORIES

- A. Wall Plates: Single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which they are attached, and are from the same manufacturer. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Wall plate color shall be as selected by Architect / Engineer. Provide wall plate color to match wiring devices except as otherwise indicated. Provide wall plates with engraved legend where indicated. Conform to requirements of Section 260553, "Electrical Identification".

1. Interior Areas: Smooth, high-impact resistant plastic, of the same manufacturer as the device.
  - a. Voice, data, or video communications system outlets: Same as for wiring devices except with 3/8 inch or 1 inch rubber grommets as required.
  - b. Surface mounted outlet boxes: Zinc coated sheet steel rounded edges, same size as outlet box.
  - c. Kitchen and food preparation areas: Polished stainless steel type, 0.40 inches thick.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install wiring devices and accessories as indicated, in accordance with manufacturers written instructions, applicable requirements of the CEC, and in accordance with recognized industry practices to fulfill project requirements.
  1. Mount switches and receptacles in vertical position in building interiors.
  2. Mount receptacles with weatherproof plates in horizontal position.
  3. Install receptacles mounted vertically so that the ground contact falls on the top position, and horizontally mounted receptacles with neutral pole in top position.
- B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.
- C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt and debris.
- D. Install wiring devices after wiring work is completed.
- E. Install wallplates after painting work is completed.
- F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturers' torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A. Use properly-scaled torque indicating hand tool.

#### **3.2 INSPECTION**

- A. Inspect boxes into which wiring devices are to be installed for defects which affect the quality and execution of work.
- B. Do not start work until defects are corrected.

#### **3.3 PREPARATION**

- A. Determine where types of wiring devices are to be installed.
- B. Verify devices are of correct size, capacity, type, and NEMA configuration.

#### **3.4 ADJUSTMENT**

- A. Align device and cover plate vertically and horizontally assuring flush fitting.

### 3.5 PROTECTION

- A. Protect installed components from damage. Replace damaged items prior to final acceptance.

### 3.6 FIELD QUALITY CONTROL

- A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.
- B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

**END OF SECTION**





**SECTION 26 28 16**  
**ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

**PART 1 - GENERAL**

1.1 SUMMARY

A. This Section Includes:

1. Enclosed safety switches for use on feeders and branch circuits, and disconnect switches for motors and equipment.
2. Fuses.

B. Related Sections:

1. Boxes, cabinets, and fittings: Section 260533.13.
2. Grounding and bonding: Section 260526.
3. Supporting devices: Section 260529.
4. Electrical identification: Section 260553.

1.2 REFERENCES

A. Drawings and general provisions of the Contract, including General- and Supplementary-Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. In addition, the products covered in this Section, except as noted, shall be designed, manufactured, and tested in accordance with the latest revisions of the applicable standards of:

1. ANSI American National Standards Institute
2. ASTM American Society for Testing and Materials
3. IEEE Institute of Electrical and Electronics Engineers
4. NEC National Electrical Code (NFPA 70)
5. NECA National Electrical Contractors Association "Standard of Installation"
6. National Electrical Manufacturers Association

NEMA KS 1 Enclosed Switches  
NEMA FU 1 Low Voltage Cartridge Fuses

7. NFPA National Fire Protection Association
8. Underwriters Laboratories, Inc.

UL 98 Enclosed and Dead Front Switches  
UL 198C High-Interrupting Capacity Fuses; Current Limiting Type  
UL 198E Class R Fuses  
UL 977 Fused Power Circuit Devices

1.3 SUBMITTALS

A. General: Submit the following in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500.

B. Shop Drawings: Include enclosure dimensions, type, electrical ratings, fuse provision, installation

instructions, and nameplate nomenclature.

- C. Product Data: Submit for each type of product specified.
- D. Operating, Maintenance, and Instructional Data: Manufacturers' written operating, maintenance, and installation instructions, including directions for storage and protection, handling, examination, and preparation.
  - 1. In addition, include copies of this data in Operating and Maintenance Manuals submitted, see Section 260500.
- E. Samples: Provide samples upon specific request.
- F. Certificates: Labels of UL listing, fixed to each item of material.

#### 1.4 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA and UL Compliance: Products shall comply with applicable requirements of NEMA and UL standards. Provide products and components listed and labeled by UL.
- D. NECA Installation Standards: Perform work in accordance with NECA "Standard of Installation."
- E. Source Quality Control: Quality control testing shall meet applicable Underwriters' Laboratories Inc. Standards.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, protect, and handle products to site in accordance with the General- and Supplementary Conditions, Division 1 Specification Sections, and Section 260500.
- B. Store and protect product in accordance with manufacturer's instructions, and in a manner to prevent damage from the elements, personnel, equipment, and moisture.

#### 1.6 PROJECT CONDITIONS OR SITE CONDITIONS

- A. Verify that field measurements are as shown prior to commencing the work.

#### 1.7 COORDINATION

- A. For equipment furnished by the Owner, or under other Divisions: Size fuses in accordance with the National Electrical Code.

#### 1.8 EXTRA MATERIALS

- A. Furnish 3 of each type and size of fuse installed.
- B. Furnish 2 fuse pullers.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. General Electric
- B. Square D
- C. Cutler-Hammer
- D. Fuses: Cooper Bussman, Ferraz Shawmut, Littlefuse

### **2.2 MATERIALS**

- A. For single phase motors under 2 horsepower Allen Bradley Bulletin 600 single phase manual switch, toggle type, with locking attachment, neon pilot light, heater elements sized per motor nameplate rating, NEMA 1 enclosure indoors, NEMA 4 enclosure exterior, in damp and wet locations, flush and surface as specified for outlet boxes.
- B. For other 250 volt equipment: NEMA Type HD, General Electric Type TH, fusible and non-fusible as required by NEC, with cover interlocks, with cabinets, with threaded hubs.
- C. Provide heavy duty type, quick-make, quick-break disconnects with cover interlocks.
- D. Provide NEMA Type 1 enclosure for dry locations, provide the proper enclosure for other locations as indicated.
- E. Provide motor rated toggle switches where indicated.
- F. Provide Bryant #3003 disconnect for 3 phase motors up to 5 horsepower.
- G. Fuse Application:
  - 1. Main service switches larger than 600 amperes: Class L (time delay).
  - 2. Main service switches: Class RK1 (time delay)
  - 3. Power load feeder switches larger than 600 amperes: Class L (time delay)
  - 4. Power load feeder switches: Class RK1 (time delay)
  - 5. Motor load feeder switches: Class RK5.
- H. Provide rejection clips on disconnects where rejection type fuses are to be installed.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Inspect building structure to which disconnects are to be secured for defects which affect the execution and quality of work.
- B. Do not start work until defects are corrected.

### **3.2 PREPARATION**

- A. Carefully measure and lay out exact locations maintaining working clearances required by the National Electrical Code.

### **3.3 INSTALLATION**

- A. Provide disconnects where indicated and where required by the National Electrical Code.
- B. Install within sight of equipment served.
- C. Provide final connection to equipment served.
- D. Provide nameplate secured to cabinet with designation of equipment served, operating voltage, and circuit designation.
- E. The anchorage of motor and circuit disconnects required for elevator drives, emergency generator, emergency motor loads, fire pumps and emergency lighting shall be designed in accordance with Section 2313 of the Uniform Building Code for a lateral force based on a "Cp" value.
- F. Install fuses with label oriented such that manufacturer, type, and size are easily read.

#### 3.4 LABELING AND IDENTIFICATION

- A. Provide engraved plastic nameplates with 1/4 inch minimum height letters indicating:
  - 1. Circuit designation at branch overcurrent devices in distribution panelboards, switchboards and motor control center.
  - 2. Circuit designation of panel for device controlled on disconnects which are individually enclosed.
- B. Secure nameplates with at least two screws or rivets. Cementing and adhesive installation not acceptable.

END OF SECTION

## SECTION 26 43 13

### TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

#### 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 field-mounted TVSS for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Sections:
  - 1. Division 26 Section "Switchboards" and "Panelboards" for factory-installed TVSS.

##### 1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. SVR: Suppressed voltage rating.
- C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
- B. Qualification Data: For qualified testing agency.
- C. Product Certificates: For TVSS devices, from manufacturer.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For TVSS devices to include in emergency, operation, and maintenance manuals.
- F. Warranties: Sample of special warranties.

##### 1.5 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 testing agency, and marked for intended location and application.

- C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- D. Comply with NEMA LS 1.
- E. Comply with UL 1449.
- F. Comply with NFPA 70.

#### 1.6 PROJECT CONDITIONS

- A. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:
  - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
  - 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
  - 3. Humidity: 0 to 85 percent, noncondensing.
  - 4. Altitude: Less than 20,000 feet (6090 m) above sea level.

#### 1.7 COORDINATION

- A. Coordinate TVSS devices with Division 26 Section "Electrical Power Monitoring and Control."

### **PART 2 - PRODUCTS**

#### 2.1 SERVICE ENTRANCE SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Intermatic, Inc.
  - 4. Leviton Mfg. Company Inc.
  - 5. Liebert Corporation; a division of Emerson Network Power.
  - 6. Siemens Energy & Automation, Inc.
  - 7. Square D; a brand of Schneider Electric.
- B. Surge Protection Devices:
  - 1. Non-modular.
  - 2. LED indicator lights for power and protection status.
  - 3. Audible alarm, with silencing switch, to indicate when protection has failed.
  - 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- C. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 **kA** per phase.
- D. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2
  - 1. Line to Neutral: 80,000 A.
  - 2. Line to Ground: 80,000 A.
  - 3. Neutral to Ground: 50,000 A.

- E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 V and 208Y/120 V, 3-phase, 4-wire circuits shall be as follows (coordinate with drawings):
  - 1. Line to Neutral: 800 V for 480Y/277 V; 400 V for 208Y/120 V.
  - 2. Line to Ground: 800 V for 480Y/277 V; 400 V for 208Y/120 V.
  - 3. Neutral to Ground: 800 V for 480Y/277 V; 400 V for 208Y/120 V

## 2.2 PANELBOARD SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Intermatic, Inc.
  - 4. Leviton Mfg. Company Inc.
  - 5. Liebert Corporation; a division of Emerson Network Power.
  - 6. Siemens Energy & Automation, Inc.
  - 7. Square D; a brand of Schneider Electric.
- B. Surge Protection Devices:
  - 1. Non-modular.
  - 2. LED indicator lights for power and protection status.
  - 3. Audible alarm, with silencing switch, to indicate when protection has failed.
  - 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- C. Peak Single-Impulse Surge Current Rating: 80 kA per mode/160 kA per phase.
- D. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2:
  - 1. Line to Neutral: 80,000 A.
  - 2. Line to Ground: 80,000 A.
  - 3. Neutral to Ground: 50,000 A.
- E. Protection modes and UL 1449 SVR for grounded wye circuits with [480Y/277 V and 208Y/120 V, 3-phase, 4-wire circuits shall be as follows (coordinate with drawings):
  - 1. Line to Neutral: 800 V for 480Y/277 V; 400 V for 208Y/120 V.
  - 2. Line to Ground: : 800 V for 480Y/277 V; 400 V for 208Y/120 V.
  - 3. Neutral to Ground: 800 V for 480Y/277 V; 400 V for 208Y/120 V
- F. Protection modes and UL 1449 SVR for 240/120-V, single-phase, 3-wire circuits shall be as follows:
  - 1. Line to Neutral: 400 V.
  - 2. Line to Ground: 400 V.
  - 3. Neutral to Ground: 400 V.
- G. Protection modes and UL 1449 SVR for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
  - 1. Line to Neutral: 400 V, 800 V from high leg.

2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

### 2.3 ENCLOSURES

- A. Indoor Enclosures: NEMA 250 Type 1.
- B. Outdoor Enclosures: NEMA 250 Type 3R

## **PART 3 - EXECUTION**

### 3.1 INSTALLATION

- A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
  1. Provide multiple, 60-A circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated or required by manufacturer.

### 3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
  2. After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements.
  3. Complete startup checks according to manufacturer's written instructions.
- C. TVSS device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.3 STARTUP SERVICE

- A. Do not energize or connect service entrance equipment, panelboards, control terminals, or data terminals to their sources until TVSS devices are installed and connected.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to maintain TVSS devices.

END OF SECTION 264313







# APPENDIX A





FOR REFERENCE ONLY

**Tri City Medical Center  
Oceanside, California  
USA**

REV	DATE	MODIFICATIONS
D	10/Dec/2020	Revision based on request DC-247285 : Update walls
C	16/MAR/2020	Revision based on request DC-221300 : Secondary magnetic shield updated
B	21/Feb/2020	Revision based on request DC-220690 : Secondary magnetic shield added
A	13/Feb/2020	Final based on request DC-220449

REV	DATE	MODIFICATIONS
01 - C1 - Cover Sheet		16 - S3 - Structural Details
02 - C2 - Disclaimer - Site Readiness		17 - M1 - Mechanical Layout
03 - A1 - General Notes		18 - M2 - HVAC-Venting
04 - A2 - Equipment Layout		19 - M3 - Chilled Water
05 - A3 - Section Views		20 - M4 - Cryogenics (1)
06 - A4 - Acoustic - Proximity Limits		21 - M5 - Cryogenics (2)
07 - A5 - RF shielding		22 - E1 - Electrical Notes
08 - A6 - Equipment Details (1)		23 - E2 - Electrical Layout
09 - A7 - Equipment Details (2)		24 - E3 - Electrical Elevations
10 - A8 - Delivery		25 - E4 - Electrical Details
11 - A9 - Shield Requirements (1)		26 - E5 - Power Requirements
12 - A10 - Shield Requirements (2)		27 - E6 - Interconnections
13 - A11 - Shield Requirements (3)		
14 - S1 - Structural Notes		
15 - S2 - Structural Layout		



**GE Healthcare**

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**DISCOVERY MR750W  
FINAL STUDY**

**A mandatory component of this drawing set is the GE Healthcare Pre Installation manual. Failure to reference the Pre Installation manual will result in incomplete documentation required for site design and preparation.**  
Pre Installation documents for GE Healthcare products can be accessed on the web at: [www.gehealthcare.com/siteplanning](http://www.gehealthcare.com/siteplanning)

GE does not take responsibility for any damages resulting from changes on drawings made by others. Errors may occur by not referring to the complete set of final issue drawing. GE cannot accept responsibility for any damage due to the partial use of GE final issue drawings, however caused. All dimensions are in millimeters unless otherwise specified. Do not scale from printed pdf files. GE accepts no responsibility or liability for defective work due to scaling from these drawings.

Drawn by	Verified by	Concession	S.O. (GON)	PIM Manual	Rev
PM	PM	-	4825636	5670003	9
Format	Scale	File Name		Date	Sheet
A3	1/4"=1'-0"	MRI-M202382-FIN-01-D.DWG		10/Dec/2020	01/27

## DISCLAIMER

### GENERAL SPECIFICATIONS

- GE is not responsible for the installation of developers and associated equipment, lighting, cassette trays and protective screens or derivatives not mentioned in the order.
- The final study contains recommendations for the location of GE equipment and associated devices, electrical wiring and room arrangements. When preparing the study, every effort has been made to consider every aspect of the actual equipment expected to be installed.
- The layout of the equipment offered by GE, the dimensions given for the premises, the details provided for the pre-installation work and electrical power supply are given according to the information noted during on-site study and the wishes expressed by the customer.
- The room dimensions used to create the equipment layout may originate from a previous layout and may not be accurate as they may not have been verified on site. GE cannot take any responsibility for errors due to lack of information.
- Dimensions apply to finished surfaces of the room.
- Actual configuration may differ from options presented in some typical views or tables.
- If this set of final drawings has been approved by the customer, any subsequent modification of the site must be subject to further investigation by GE about the feasibility of installing the equipment. Any reservations must be noted.
- The equipment layout indicates the placement and interconnection of the indicated equipment components. There may be local requirements that could impact the placement of these components. It remains the customer's responsibility to ensure that the site and final equipment placement complies with all applicable local requirements.
- All work required to install GE equipment must be carried out in compliance with the building regulations and the safety standards of legal force in the country concerned.
- These drawings are not to be used for actual construction purposes. The company cannot take responsibility for any damage resulting therefrom.

### CUSTOMER RESPONSIBILITIES

- It is the responsibility of the customer to prepare the site in accordance with the specifications stated in the final study. A detailed site readiness checklist is provided by GE. It is the responsibility of the customer to ensure all requirements are fulfilled and that the site conforms to all specifications defined in the checklist and final study. The GE Project Manager of Installation (PMI) will work in cooperation with the customer to follow up and ensure that actions in the checklist are complete, and if necessary, will aid in the rescheduling of the delivery and installation date.
- Prior to installation, a structural engineer of record must ensure that the floor and ceiling is designed in such a way that the loads of the installed system can be securely borne and transferred. The layout of additional structural elements, dimensioning and the selection of appropriate installation methods are the sole responsibility of the structural engineer. Execution of load bearing structures supporting equipment on the ceiling, floor or walls are the customer's responsibility.

<b>THE UNDERSIGNED, HEREBY CERTIFIES THAT I HAVE READ AND APPROVED THE PLANS IN THIS DOCUMENT.</b>		
<b>DATE</b>	<b>NAME</b>	<b>SIGNATURE</b>

## GLOBAL SITE READINESS CHECKLIST (DI)

DOC1809666 Rev. 6

Customer Name:	PMI Name:
GON/SO Number:	Field Service Name:
Equipment:	Country/City or City/State:
Site Visit Date for SRC:	SRC Status:
<b>Site Ready Checks at Installation</b>	
<b>General Site Planning</b>	
Room dimensions, including ceiling height, for all Exam, Equipment/Technical & Control rooms meets GE specifications.	
Ceiling support structure, if on the GE drawing, is at correct location and height according to the drawing specifications. Levelness and spacing has been measured. Overhead support Structure has been confirmed with contractor to meet GE criteria.	
Rooms that will contain equipment, including staging areas if applicable, are construction debris free. Precautions must be taken to prevent debris from entering rooms containing equipment.	
Finished ceiling is installed. If applicable ceiling tiles installed per PMI discretion.	
Delivery route from truck to installation space has been reviewed, all communications have occurred, arrangements made for special handling (if needed). Floors along delivery route will support weight of the equipment, reinforcements arranged if needed.	
System power & grounding (PDB/MDP) is available as per GE specifications, installed at point of final connection and ready to use. Lock Out Tag Out is available.	
System power and grounded audit has been scheduled to be completed during installation of equipment. (If Required) GEHC PM to confirmed if needed.	
Adequate room illumination installed and working.	
Cableways (floor, wall, ceiling, etc.) ready for GE cables and are of correct length and diameter. Cableways routed per GE Final drawings and access openings installed as determined by GEHC PM. Surface floor duct installed at time of system installation.	
HVAC systems Installed, and the site meets minimum environmental operational system requirements.	
Network outlets installed and computer network available and working.	
Hospital IT/connectivity contacts have been engaged and information has been added to Project management tool. (If Required)	
Floor levelness/flatness is measured and within tolerance, and there are no visible defects per GEHC specifications. Floor Strength and thickness have been discussed with customer/contractor and they have confirmed GE requirements are met.	
Customer supplied countertops where GE equipment will be installed are in place.	
<b>Specific for MR</b>	
RF Shield installed with possible exception of magnet entrance. RF Shield Effectivity and Ground Isolation Test needed. If GE is supplying RF shield, the RF shield Effectivity and Ground Isolation Test data is a Mandatory attachment into MyProjects.	
Power and connectivity is available for magnet monitoring.	
Delivery route for He dewars & gradient coil cart to the scanning room is available.	
Chilled water supply for Water Cooled Compressor or Air Cooled Compressor is ready and meets GE specifications.	
Water drain available in the equipment room, if applicable.	
Power for MR compressor & Chiller is available.	
Ensure cryogen venting system is available for magnet connection.	
Exhaust fan system is installed and operational per GE requirements.	
PMI Signature:	
Customer Signature:	
FS Signatature: optional	

# FOR REFERENCE ONLY

## CUSTOMER SITE READINESS REQUIREMENTS

- Any deviation from these drawings must be communicated in writing to and reviewed by your local GE healthcare installation project manager prior to making changes.
- Make arrangements for any rigging, special handling, or facility modifications that must be made to deliver the equipment to the installation site. If desired, your local GE healthcare installation project manager can supply a reference list of rigging contractors.
- New construction requires the following;
  - Secure area for equipment,
  - Power for drills and other test equipment,
  - Capability for image analysis,
  - Restrooms.
- Provide for refuse removal and disposal (e.g. crates, cartons, packing)
- It is the customer's responsibility to contract a vibration consultant/engineer to implement site design modifications to meet the GE vibration specification. Refer to the system preinstallation manual for the vibration specification.

## MRI SITE PLANNING REMINDERS

Please refer to pre-installation checklist in pre-installation manual listed on the cover sheet for items critical to image quality.

- The layout should be arranged so that the 5g line is contained to the magnet room. If not possible, a barrier is recommended to prevent entry to the 5g field area.
- The spaces around, above, and below the magnet must be reviewed for effects of the 5g, 3g, 1g, and .5g fields. Refer to the proximity limit chart in the MR pre-installation manual referenced on the cover sheet.
- For moving metal, the restriction lines typically extend outside of the MR space. Please confirm there are no moving metal concerns within these areas. An EMI study is recommended if the restriction lines are violated.
- For vibration, analysis to be completed as required per pre-installation manual.
- For EMI, review the site for the location of the main electrical feeders, AC devices, or distribution systems. An EMI study is recommended if large AC systems are nearby.
- Details of the floor below the magnet must be reviewed. The structural engineer must verify that the quantity of steel in the volume 10ft [3.1m] x 10ft [3.1m] x 1ft [.3m] deep (below the magnet) does not exceed the allowable steel content as given in the MR pre-installation manual referenced on the cover sheet.
- All access/computer flooring is to be removed in both the magnet room and equipment room.

Responsibility for the coordination, design, engineering, and site preparation resides with the customer and their project architects and contractors. GE does not, by providing reviews and furnishing comments and assistance, accept any responsibility beyond its obligations as defined in the MR system, sale/purchase agreement.

## IMAGE QUALITY CONSIDERATIONS

Broadband RF noise is a single transient or continuous series of transient disturbances caused by an electrical discharge. Low humidity environmental conditions will have higher probability of electrical discharge. The electrical discharge can occur due to electrical arcing (micro arcing) or merely static discharge. Some potential sources capable of producing electrical discharge include:

- Loose hardware/fasteners vibration or movement (electrical continuity must always be maintained)
- Flooring material including raised access flooring (panels & support hardware) and carpeting
- Electrical fixtures (i.e. Lighting fixtures, track lighting, emergency lighting, battery chargers, outlets)
- Ducting for HVAC and cable routing
- RF shield seals (walls, doors, windows etc.)

For additional information regarding image quality, refer to the pre-installation manual listed on the cover sheet.

## MAGNETIC INTERFERENCE SPECIFICATIONS

- The customer must establish protocols to prevent persons with cardiac pacemakers, neurostimulators, and biostimulation devices from entering magnetic fields of greater than 5 gauss (exclusion zone).
- Main power transformers must remain outside the 3 gauss field. EMI < 17.1mG AC. EMI < 4.1mG DC.
- Potential exists under fault conditions that the 5 gauss line may expand radially to 14.8 ft. [4.5 m] and axially to 19.7 ft. [6.0 m] for 8 seconds or less. It should be noted that normal rampdowns or magnet rundown unit initiated quenches will not cause the magnetic field to expand.
- It is recommended every site consider the event of a quench and plan accordingly (such as placing 5 gauss warning signs at expanded locations).
- The ferrous metal objects listed below must not move into or inside of the moving metal sensitivity line during scans.

**FOR REFERENCE ONLY**

TYPICAL MOVING MAGNETIC MASS	DISTANCE RADIALLY		DISTANCE AXIALLY	
Carts, Gurneys 100-400 lbs [45-182 kg]	3 Gauss line		3 Gauss line	
Forklifts, small elevator, cars, minivans vans, pickup trucks, ambulances (objects greater than 400 lbs [182 kg])	20.0 FT	6.05 M	25.0 FT	7.65 M
Buses and trucks (dump, tractor trailer, utility, fire trucks)	23.2 FT	7.10 M	29.2 FT	8.90 M



BY	ITEM	DESCRIPTION	MAX HEAT OUTPUT (btu)	WEIGHT (lbs)
A	1	3T Magnet	8189	16410
A	2	Rear pedestal	-	212
A	3	GEM Patient Table	-	463
A	4	Magnet rundown unit	-	7
A	5	Phantom set storage cabinet	-	350
A	6	Blower box	1535	-
A	7	Penetration cabinet	1024/ 10697	639
A	8	Secondary penetration wall	-	92
A	9	Power, gradient, RF cabinet	20940	3144
A	10	Heat exchanger cabinet	3412	1350
A	11	Magnet monitor	819	10
A	12	Cryocooler compressor	1706	264

BY	ITEM	DESCRIPTION	MAX HEAT OUTPUT (btu)	WEIGHT (lbs)
A	13	Operator console computer	4947	141.75
A	14	Operator workspace	-	26
A	15	Pneumatic patient alert	-	0.5
A	16	700 va partial UPS	-	26
B	17	Main disconnect panel	901	130
B	18	Dimplex chiller	240002	4301
B	19	Water filter	-	-
B	20	Remote graphic display	-	-
B	21	Water bypass	-	-
D	22	DC lighting controller	-	-
D	23	DC lighting transformer	-	-
D	24	Metal detector (hand held)	-	-
C	25	Minimum opening for equipment delivery is 40 in. w x 82 in. h, contingent on a 72 in. corridor width		

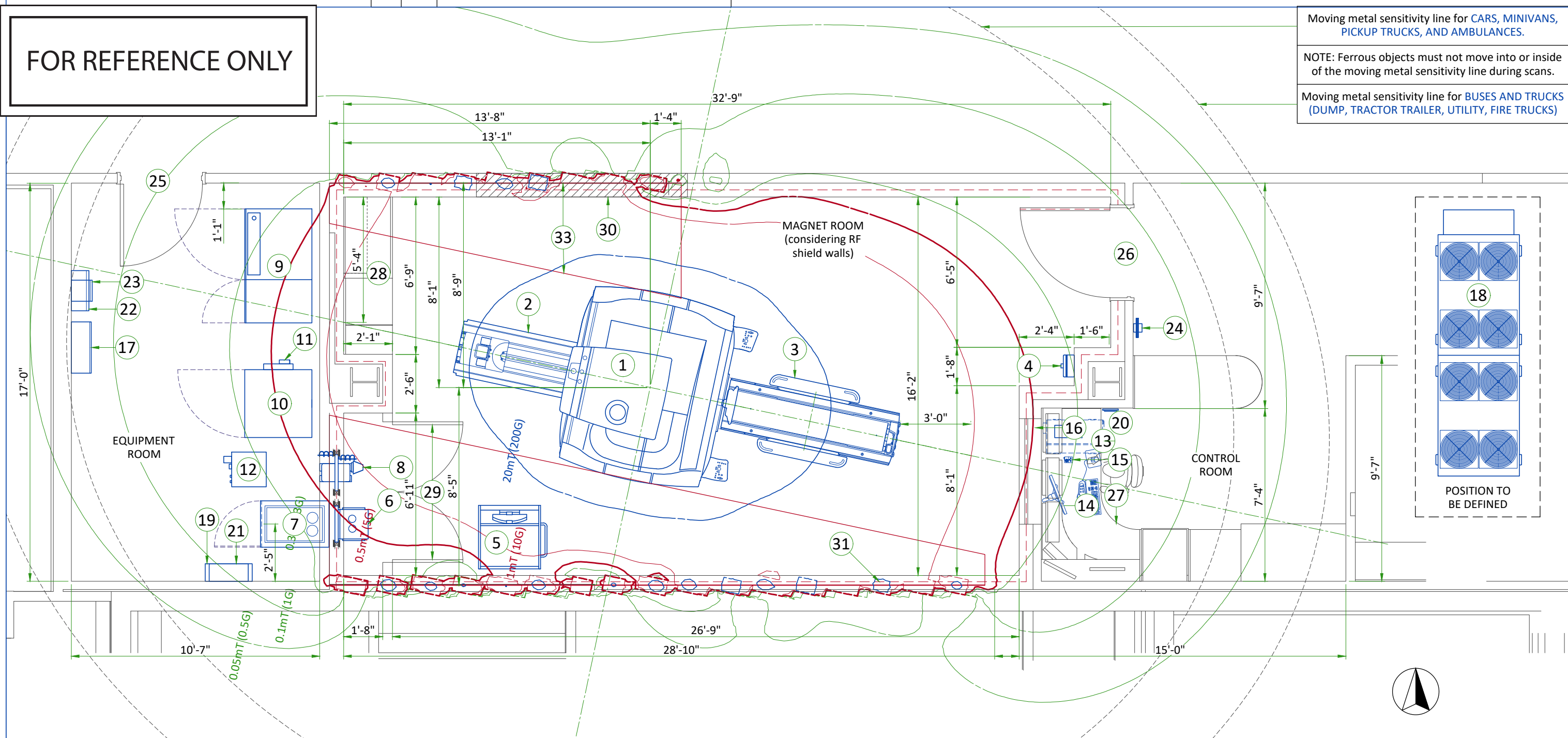
BY	ITEM	DESCRIPTION	MAX HEAT OUTPUT (btu)	WEIGHT (lbs)
C	26	Minimum opening for equipment delivery is 43 in. w x 82 in. h, contingent on a 96 in. corridor width		
C	27	Counter top for equipment- provide grommets openings as required to route cables		
C	28	Base cabinet for storage of: surface coils, patient positioning pads, phantoms, etc.		
C	29	Louvered doors - refer to preinstall for requirements		
C	30	Magnet access 9'-0" x 9'-0"		
C	31	Define RF shield's inset according to provisions made by the RF Shield vendor		
C	32	Warning! 5 Gauss line outside the Magnet room limits		
C	33	Secondary magnetic shielding		

LEGEND			
A	GE Supplied	C	Customer/contractor supplied and installed
B	GE Supplied/contractor installed	D	Available from GE
E	Existing/ Re-installed		RF SHIELD - 100 dB ATTENUATION
	200 Gauss		5 Gauss
	100, 50, 30, 10 Gauss		3, 1, 0.5 Gauss

Exam room height	
Finished floor to slab height	T.B.D.
Finished ceiling height	8'-2.5"

The GE HPI Technical Support Group is an additional resource that can provide answers for general GE product siting questions and can be reached at (877)-305-9677 or mail to: [HPITechCOE@ge.com](mailto:HPITechCOE@ge.com)  
 For Accessory Sales: (866) 281-7545 Options 1, 2, 1, 2 or mail to: [gehaccessoriesales@ge.com](mailto:gehaccessoriesales@ge.com)

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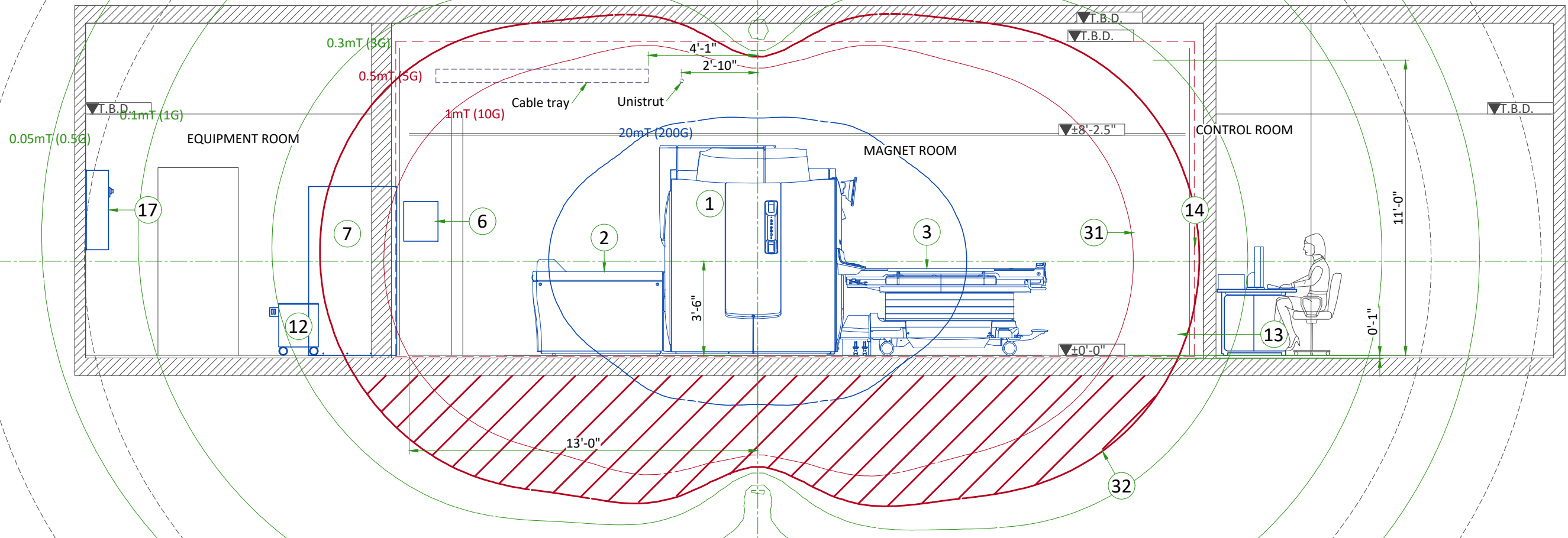


Moving metal sensitivity line for CARS, MINIVANS, PICKUP TRUCKS, AND AMBULANCES.  
 NOTE: Ferrous objects must not move into or inside of the moving metal sensitivity line during scans.  
 Moving metal sensitivity line for BUSES AND TRUCKS (DUMP, TRACTOR TRAILER, UTILITY, FIRE TRUCKS)

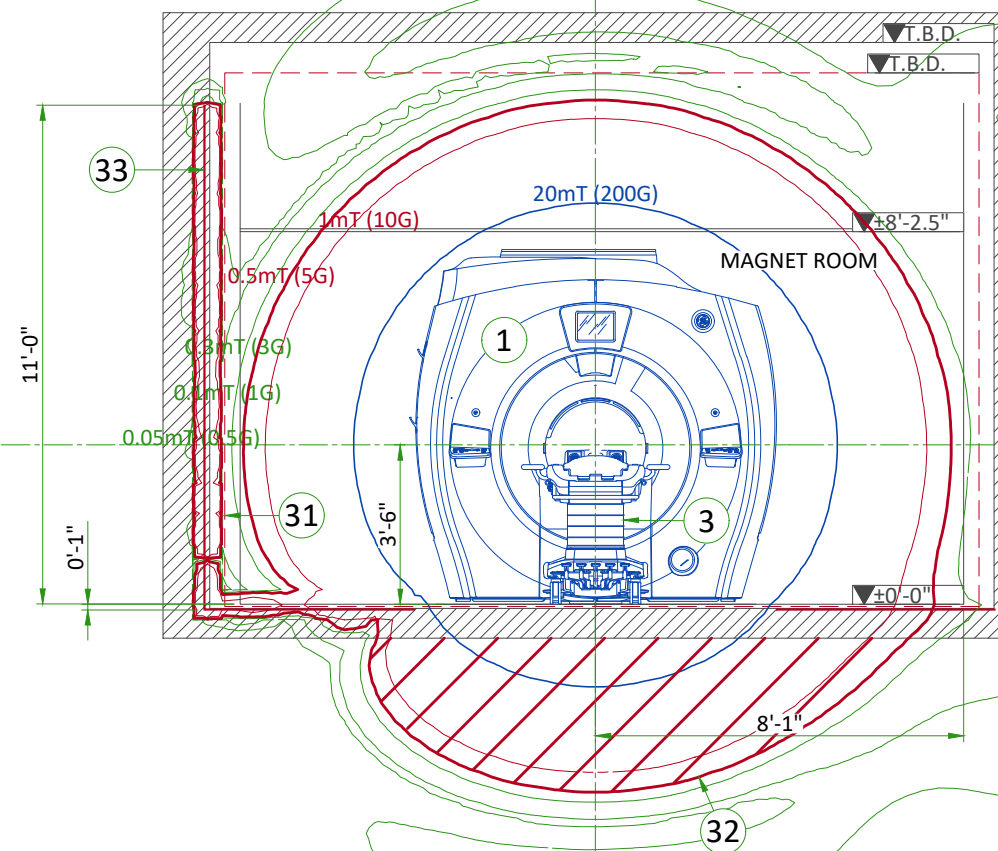




**SIDE VIEW WITH MAGNETIC FIELD**



**FRONT VIEW WITH MAGNETIC FIELD**



**FOR REFERENCE ONLY**

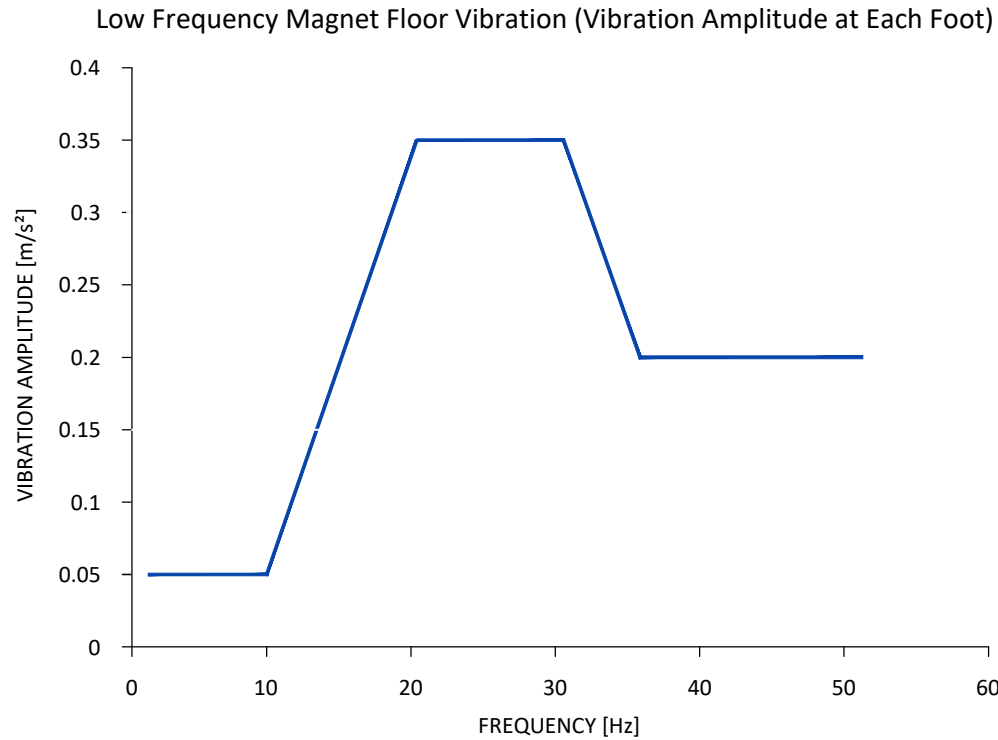
## ACOUSTICS SPECIFICATIONS

Acoustic and vibroacoustic information is provided for site planning and architectural design activities. It is the customer's responsibility to hire a qualified acoustic engineer for solutions to further attenuate this transmitted noise and vibration, if required. The actual room noise level may vary based on room design, optional equipment, and usage:

Control Room: 62 dBA  
 Equipment Room: 80 dBA  
 Magnet Room: 127 dBA\*  
 (maximum sound pressure level at magnet bore isocenter)

\* Frequency: 20 Hz to 20kHz

FREQUENCY (Hz)	AMPLITUDE (m/s <sup>2</sup> )
2	0.05
10	0.05
20	0.35
30	0.35
35	0.2
50	0.2



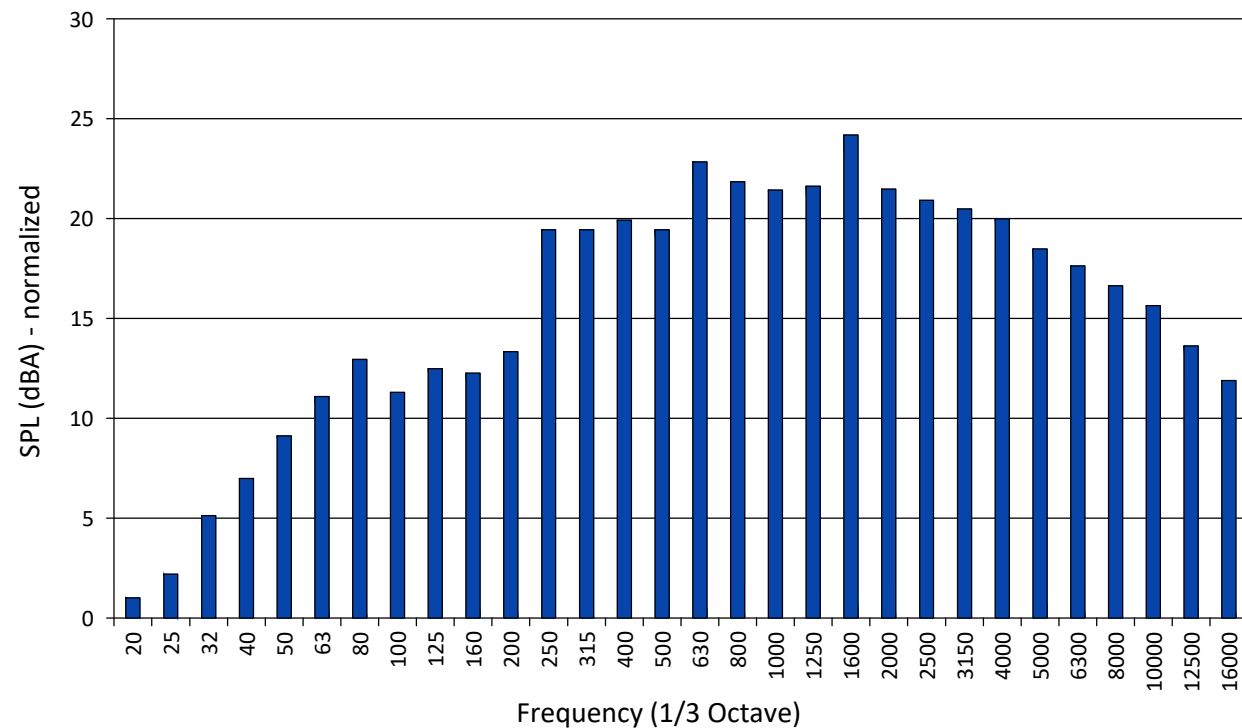
## ISOGAUSS PLOTS

The isogauss contour plots illustrated represent the performance of the system and the steel room shield described in the final shield design dated [Mar. 16, 2020](#). The actual magnetic flux density at any point in the vicinity of the magnet when installed may vary from the contour plots due to factors such as the concentrating effects of nearby ferrous objects and ambient magnetic fields, including the earth's magnetic field. Therefore, the contours shown are only approximations of actual flux densities found at corresponding distances from the magnet's isocenter.

FOR REFERENCE ONLY

## SOUND PRESSURE SPECTRAL DISTRIBUTION

1/3 Band Relative SPL



## MAGNETIC PROXIMITY LIMITS

Gauss (mT) Limit	Equipment
0.5 gauss (0.05mT)	Nuclear camera
1 gauss (0.1mT)	Positron Emission Tomography scanner, Linear Accelerator, Cyclotrons, Accurate measuring scale, Image intensifiers, Bone Densitometers, Video display (tube), CT scanner, Ultrasound, Lithotripter, Electron microscope, Digital X-Ray
3 gauss (0.3mT)	Power transformers, Main electrical distribution transformers
5 gauss (0.5mT)	Cardiac pacemakers, Neurostimulators, Biostimulation devices
10 gauss (1mT)	Magnetic computer media, Line printers, Film processor, X-ray tubes, Emergency generators, Commercial laundry equipment, Food preparation area, Water cooling equipment, HVAC equipment, Major mechanical equipment room, Credit cards, watches, and clocks, Air conditioning equipment, Fuel storage tanks, Motors greater than 5 horsepower
50 gauss (5mT)	Metal detector for screening, LCD panels, Telephones
No Limit	Digital Detectors

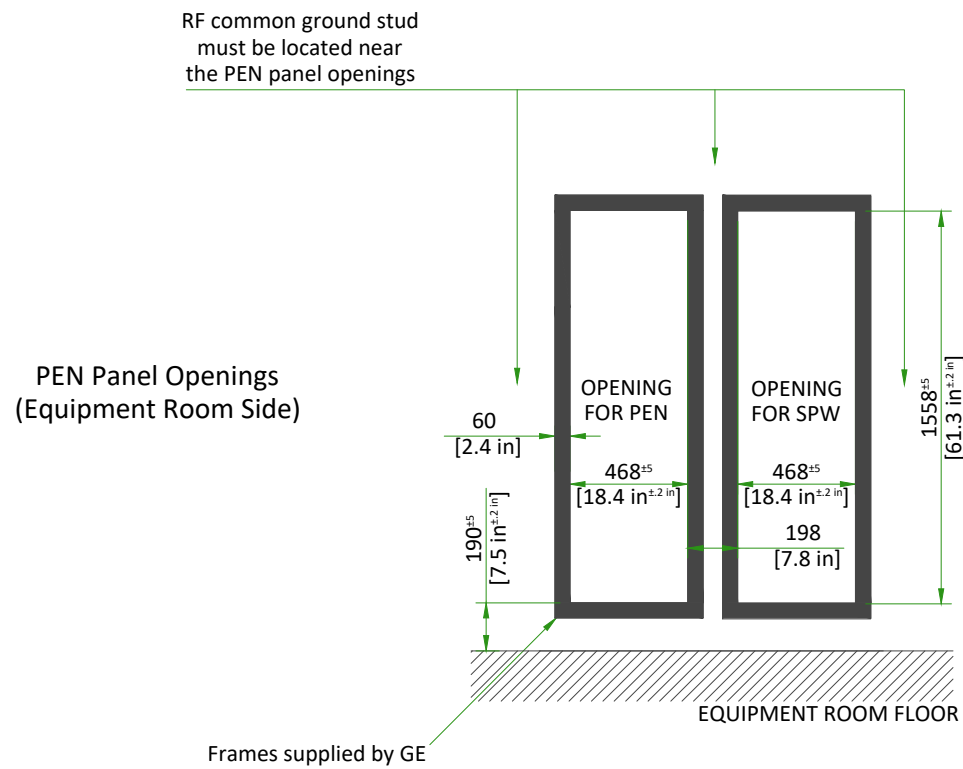
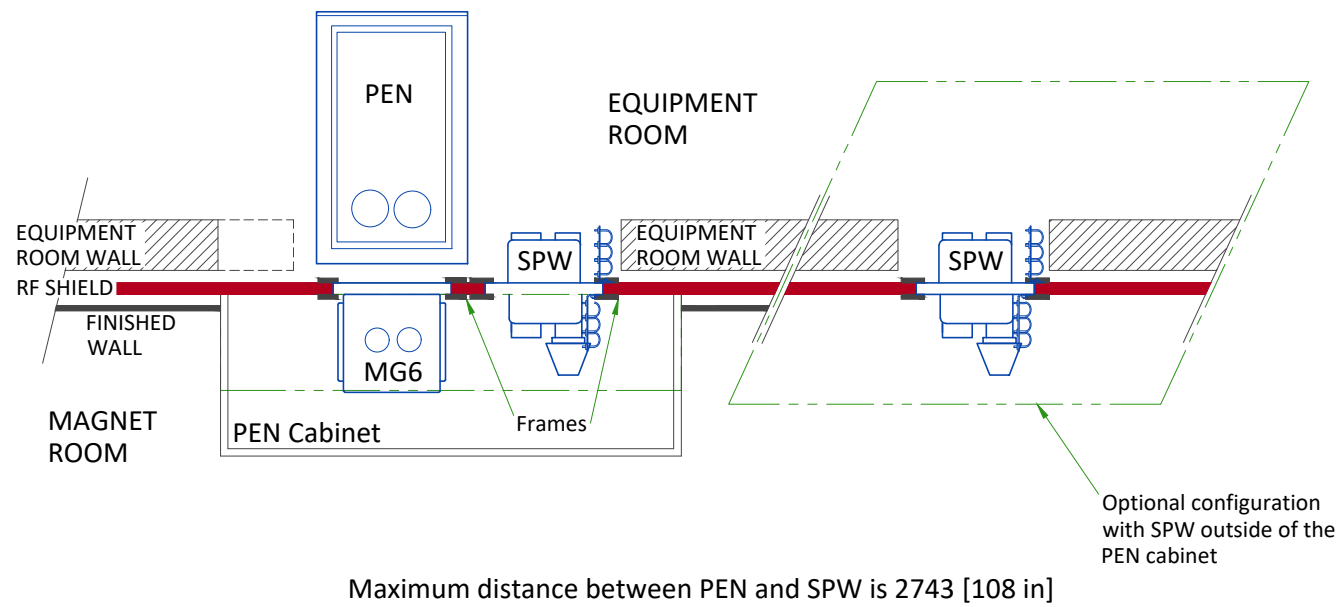
The customer must provide detail defining ferrous material below the magnet to the Project Manager so the GE Healthcare MR Siting and Shielding team can review for compliance.

### STEEL MASS LIMITS TO MAGNET ISOCENTER (3x3 m [10x10 ft] AREA UNDER MAGNET)

Limits Of Steel Mass		Distance From Magnet Isocenter		Distance Below Top Surface Of Floor	
kg/m <sup>2</sup>	lbs/ft <sup>2</sup>	mm	in	mm	in
0	0	0 - 1143	0-45	0 - 76	0-3
9.8	2	1143 - 1194	45-47	76 - 127	3-5
14.7	3	1194 - 1321	47-52	127 - 254	5-10
39.2	8	1321 - 1397	52-55	254 - 330	10-13
98.0	20	1397+	55+	330+	13+

The actual field strength can be affected by Magnetic shielding, Earth's magnetic field, other magnetic fields and stationary or moving metal. This information must be used to evaluate potential site interaction of GE Healthcare equipment with other non-GE Healthcare equipment. Magnetic shielding can be installed to prevent interaction between the magnet and nearby sensitive devices. The GE Healthcare Project Manager of Installation (PMI) can work with the customer to coordinate the magnetic shielding site evaluation. The customer is responsible for installation of all magnetic shielding.

## PENETRATION PANEL WITH SPW



SCALE 1:30

## PENETRATION PANEL CLOSET

An enclosure (i.e. closet) must be provided to restrict access to the PEN panels and for storage of excess interconnections.

- The PEN closet must have a mechanical locking mechanism to restrict access to the PEN panels
- The PEN closet must maintain the minimum service area outside the 200 Gauss in the magnet room.
- PEN closet must allow free air exchange of **400CFM (680 m<sup>3</sup>/hour)** between the Magnet room and PEN closet for MR system blowers. Airflow may be achieved through door louvers or other openings in the PEN closet that meet all other PEN closet requirements

A closet service hatch must be provided if the room does not allow the PEN panel blower box removal path to remain completely outside the 200 Gauss line.

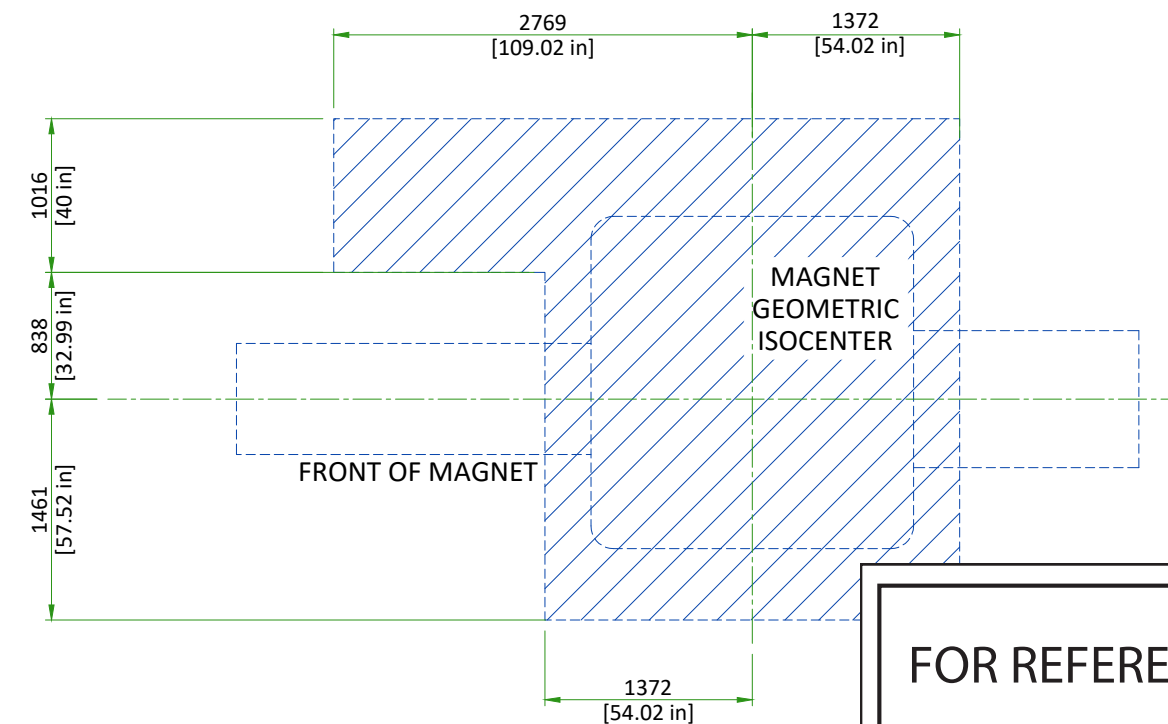
NOTE: If the room size is sufficiently large so the SPW blower box can be removed without entering the 200 Gauss line, a closet service hatch is not required.

The closet service hatch must meet the following requirements:

- Must be located within the PEN closet on the RF wall allowing access to the Equipment room
- May be located anywhere within the PEN closet (between 254 [10 in] and 1524 mm [60 in] with unobstructed pass-through)
- Must be minimum 508x508 mm [20x20 in]
- Must maintain RF shield integrity for all service access
- May use any design (quick disconnect RF panel, blanker panel, hinged door, etc.) as long as all other requirements are met
- The closet service hatch removal must take less than 15 minutes (replacement must also take less than 15 minutes)

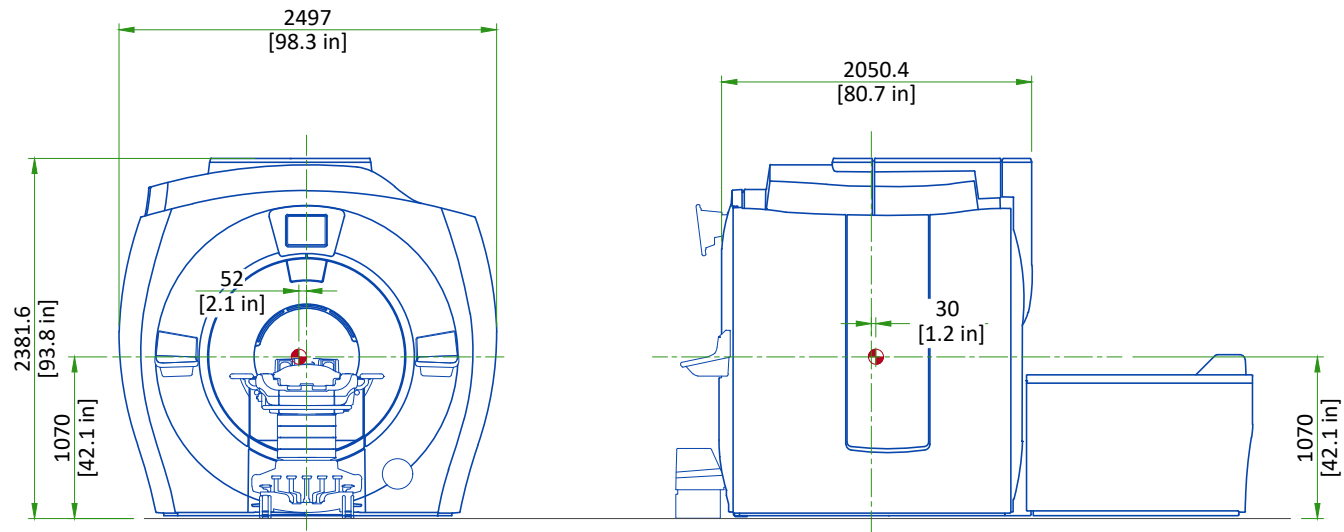
## MINIMUM MAGNET CEILING HEIGHT ( TOP VIEW )

Shaded area indicates floor to ceiling minimum height of 2500 mm (98.5 in). Special service procedures are required if ceiling height is between 2500 mm and 2667 mm (98.5 in and 105 in).



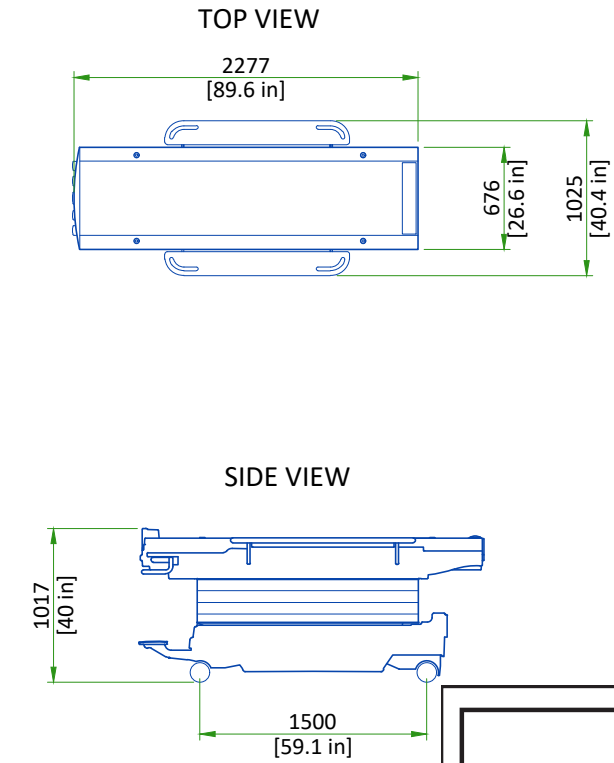
FOR REFERENCE ONLY

## MAGNET ENCLOSURE



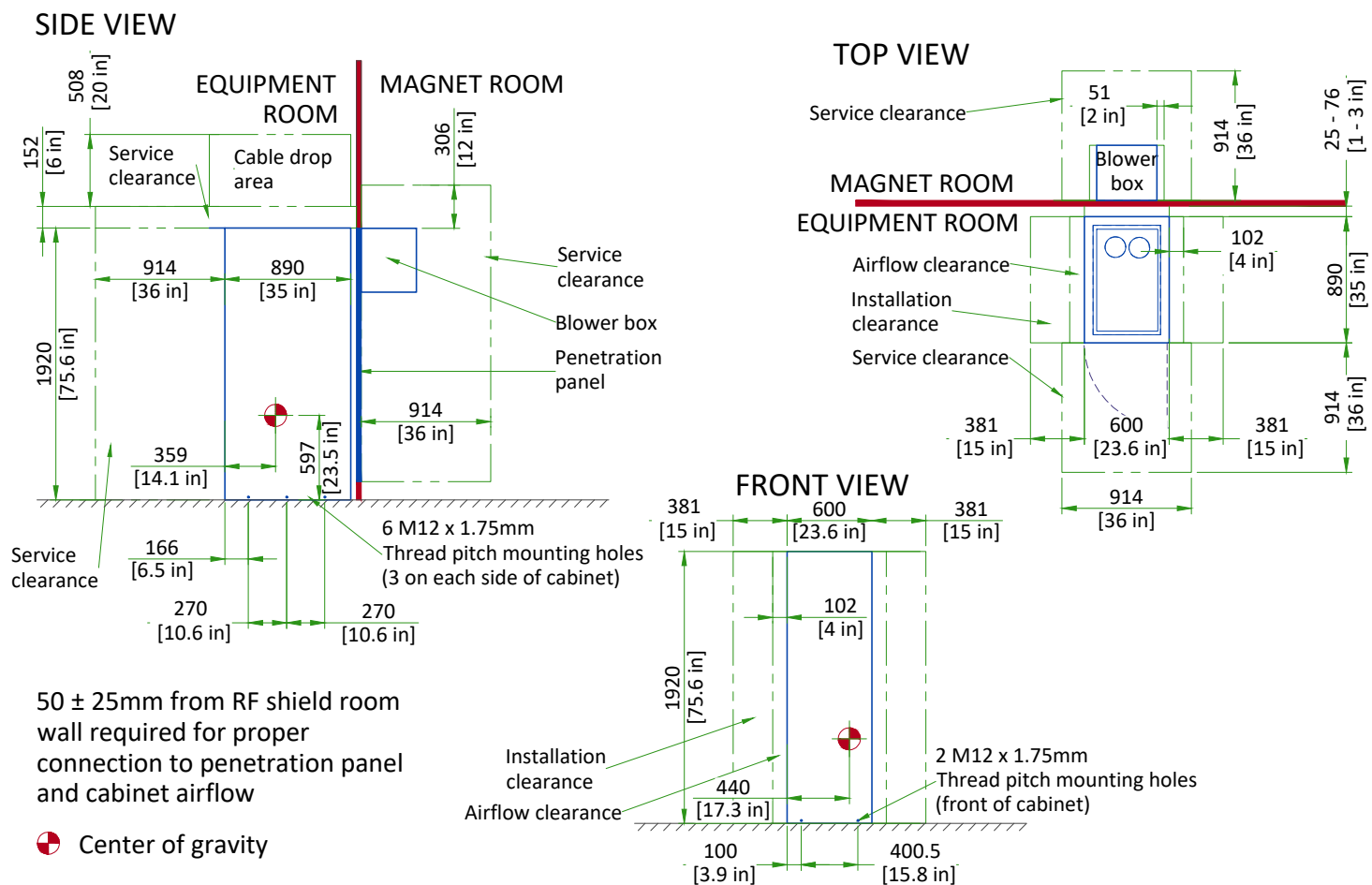
Note:  
 Center of gravity is approximate and includes the GE Healthcare supplied VibroAcoustic Dampening Kit, but does not include cryogenes, gradient assembly, side mounted electronics, or enclosures.  
 Enclosure dimensions are for reference only, NOT FOR SITE PLANNING USE.  
 ⊕ Center of gravity

## PATIENT TRANSPORT TABLE (PT)

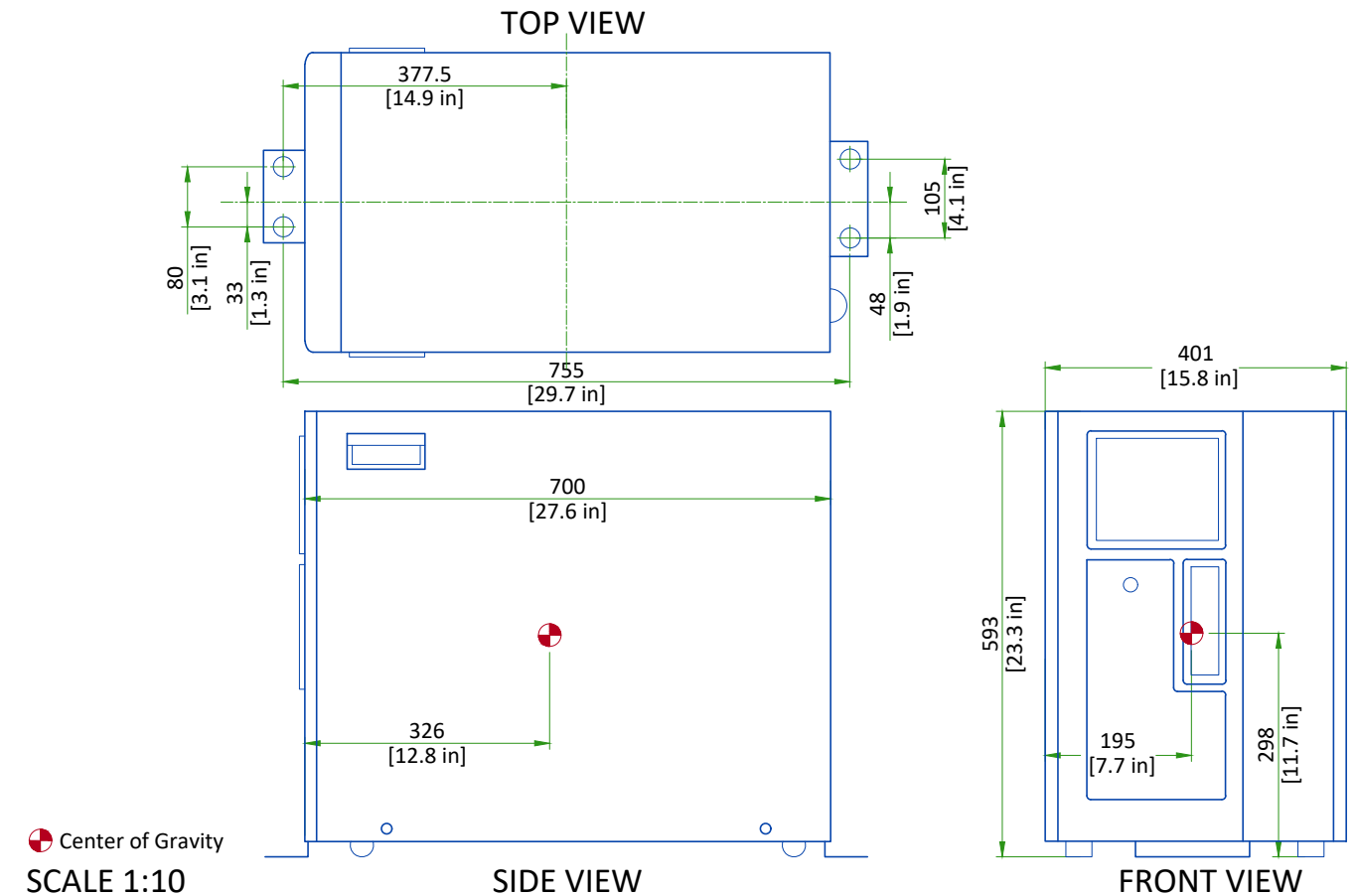


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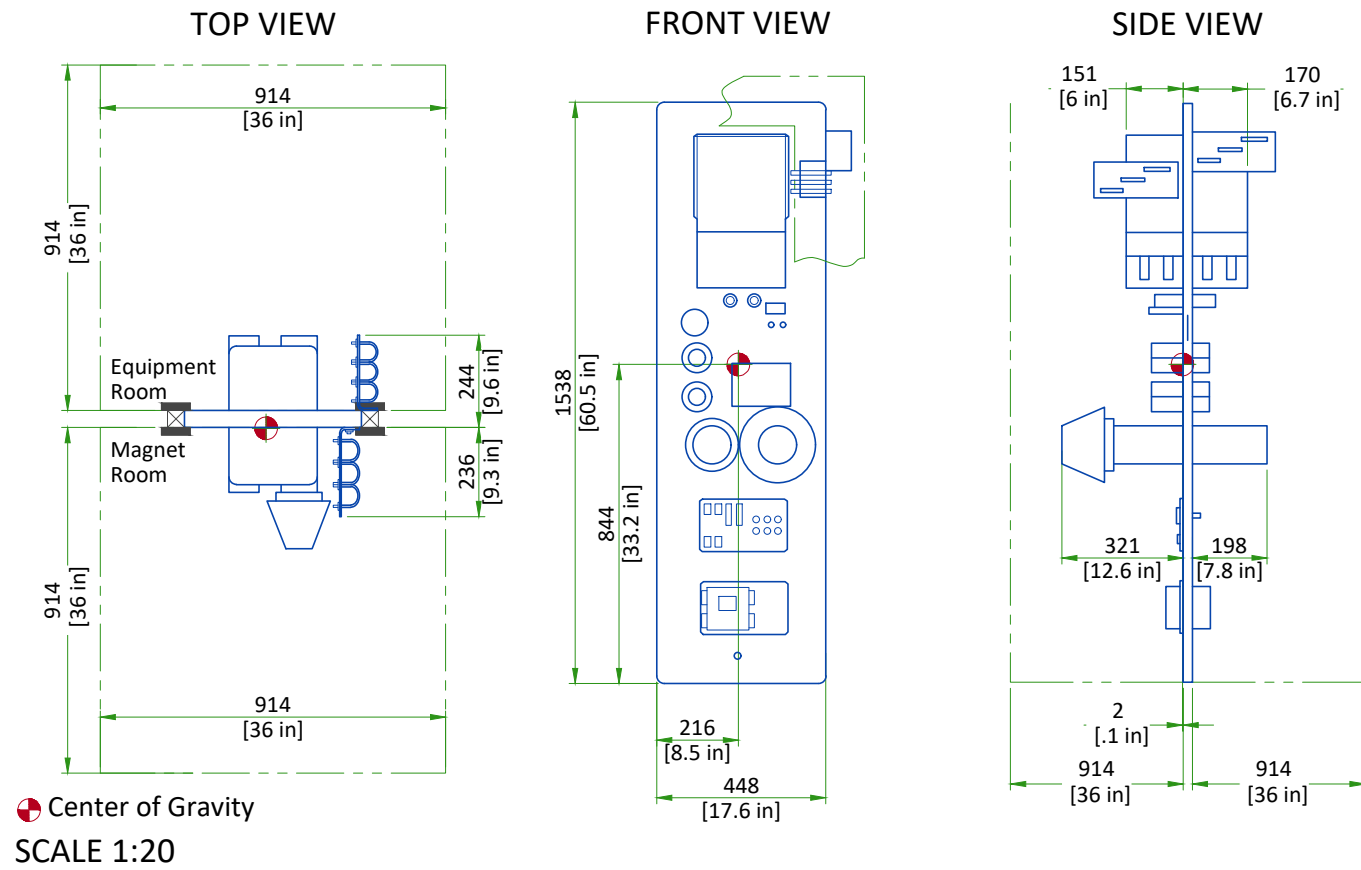
## PENETRATION CABINET CLEARANCE



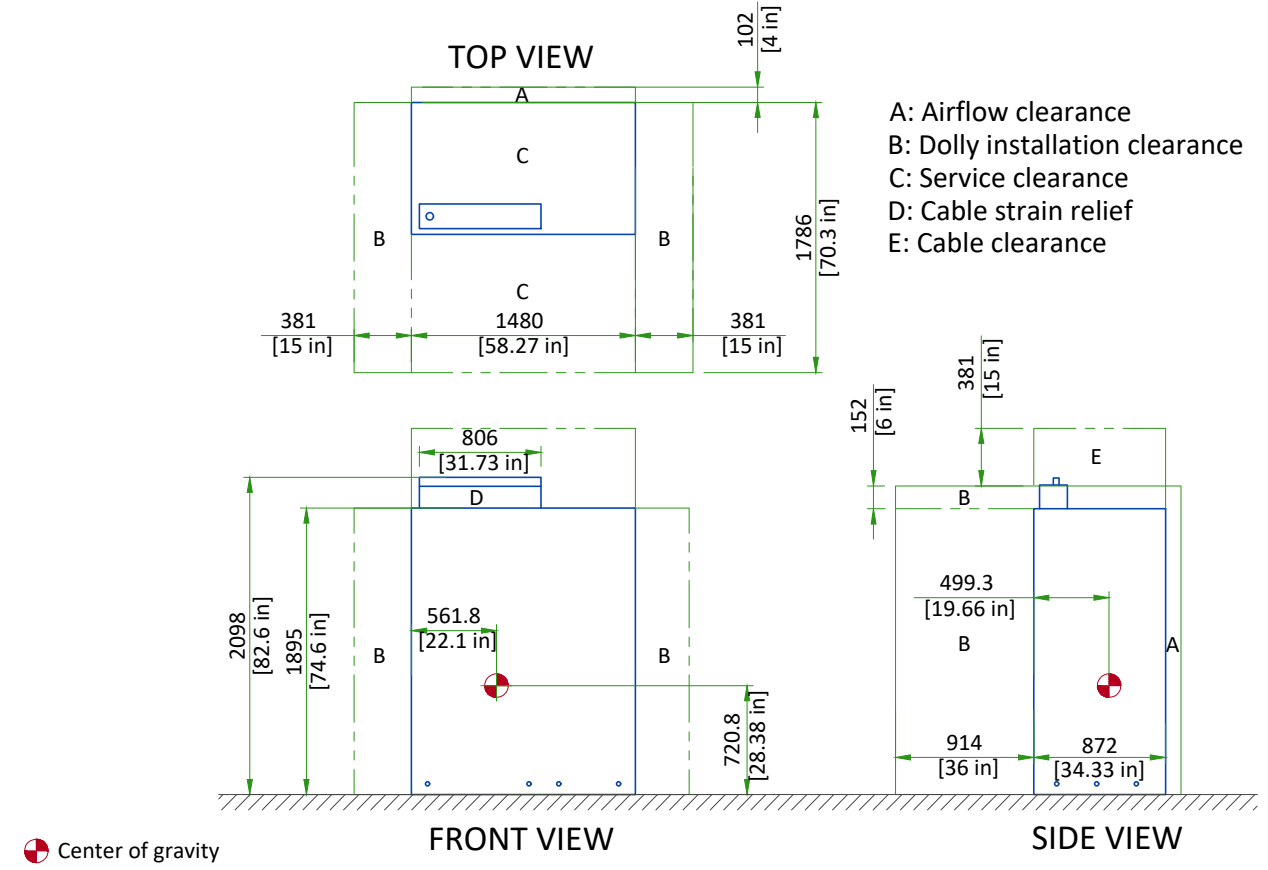
## GLOBAL OPERATORS CABINET (GOC)



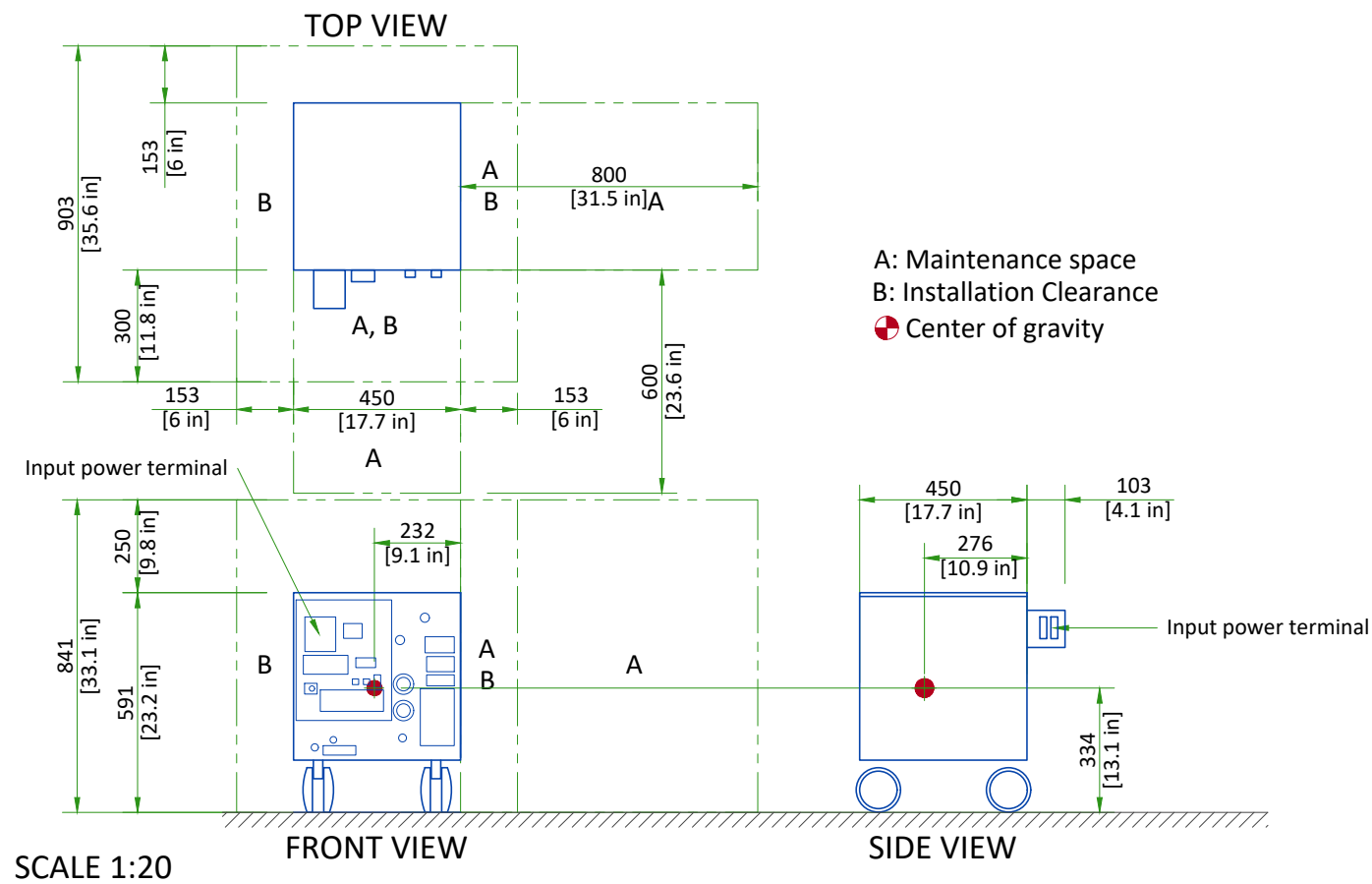
## SECONDARY PENETRATION WALL (SPW)



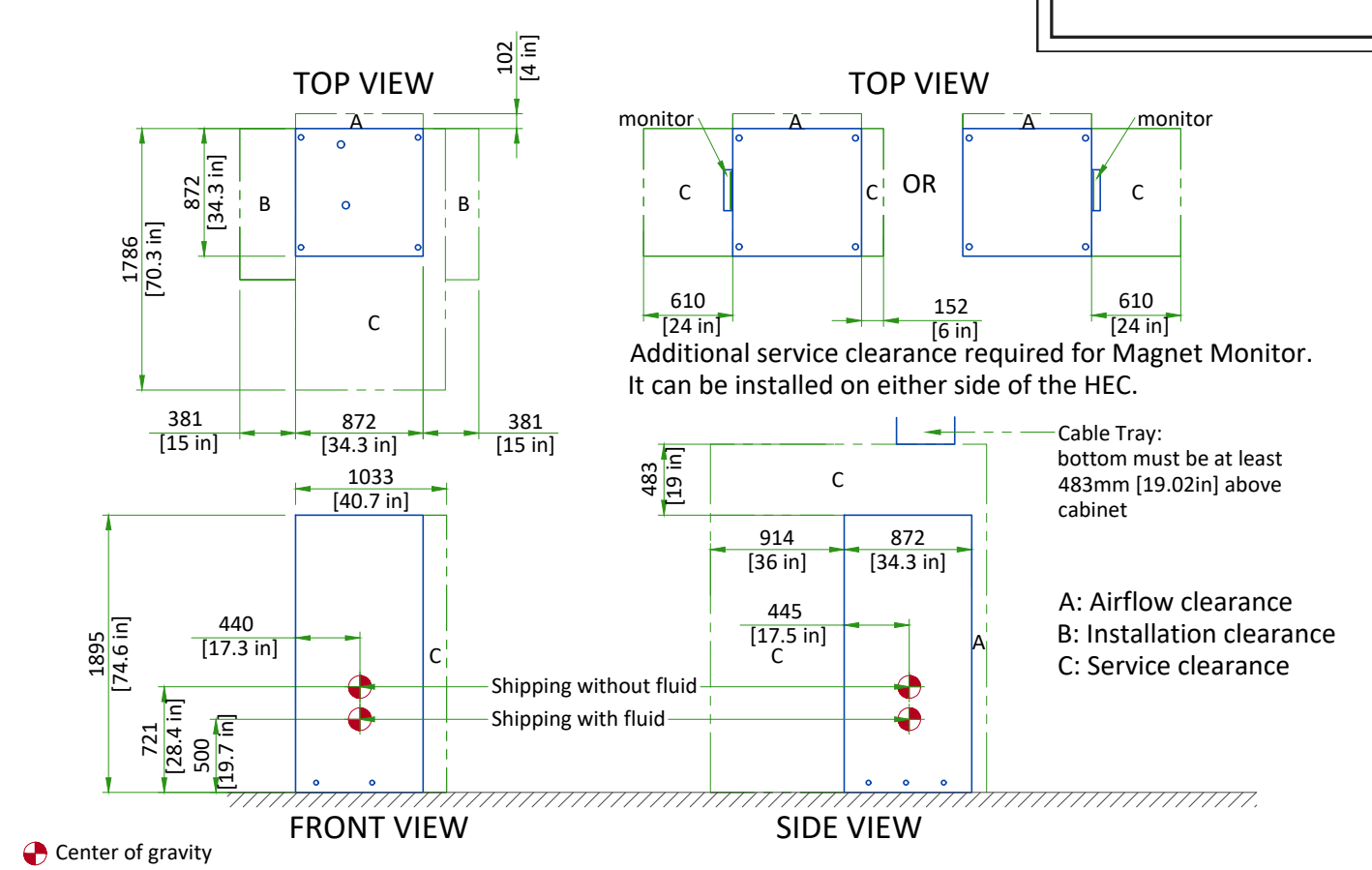
## POWER, GRADIENT, RF CABINET (PGR)



## CRYOCOOLER COMPRESSOR (CRY)



## HEAT EXCHANGER CABINET (HEC)



FOR REFERENCE ONLY



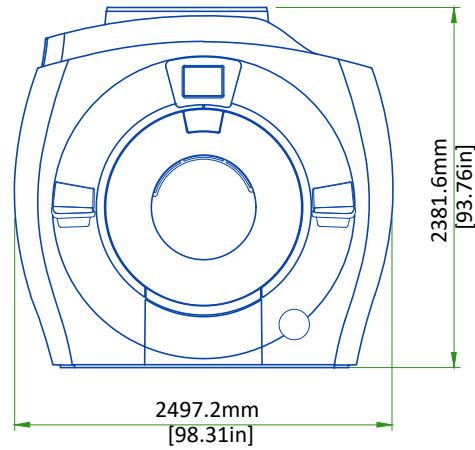
## DELIVERY

### ROUTING

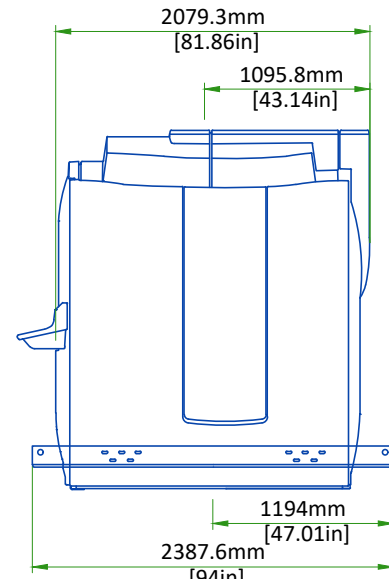
- The customer is solely liable for routing of components from dock to final site.
- GE must be able to move system components in or out with no need to uncrate or disassemble any of the components. The entire passageway must be cleared, adequately lighted and free from dust.
- The floor and its surfacing must be able to withstand the live load of components and handling equipment.
- Floor surfacing must be continuous.
- The customer must protect any fragile flooring surfaces.

### MINIMUM SPECIFICATIONS FOR MAGNET ROUTING

- Floor must be able to withstand a moving load of 7691 daN
- Height: 2.5m [98.5in], width: 2.7m [106in]
- Maximum slope: 30 degree



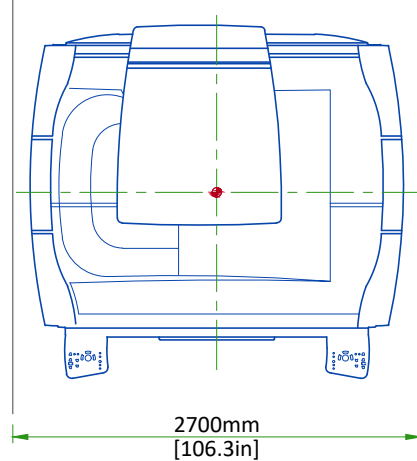
FRONT VIEW OF MAGNET



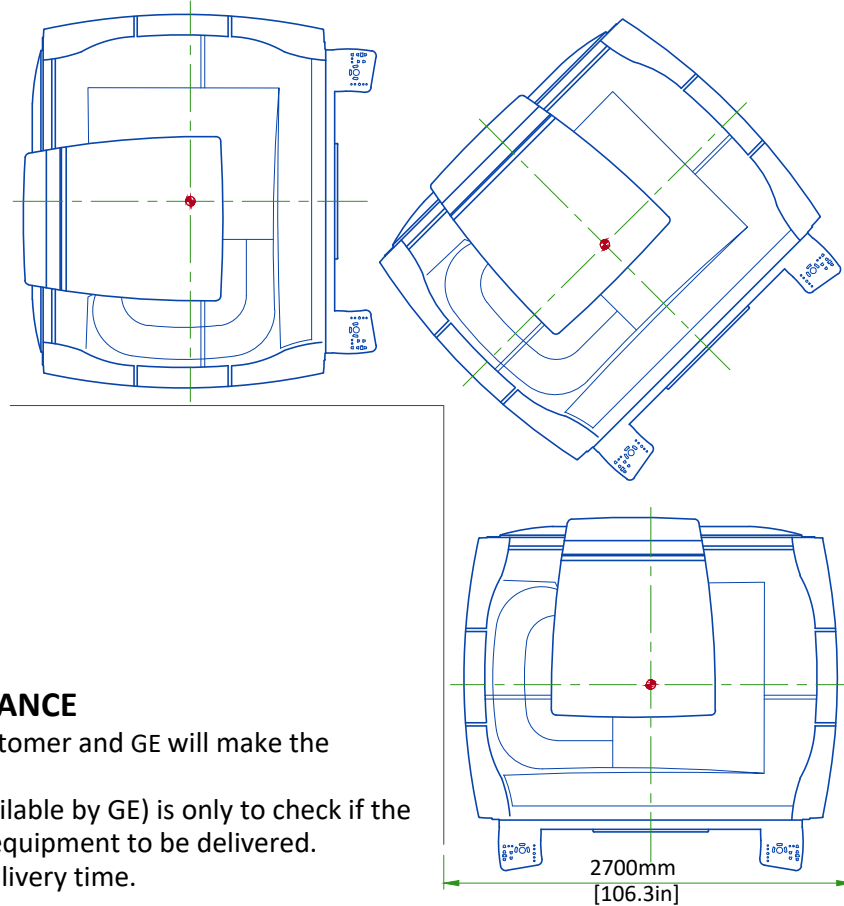
RIGHT SIDE VIEW OF MAGNET

Recommended minimum opening for side (wall) delivery : 2750 (width) x 2750 (height)

STRAIGHT PATH  
(Rigging wheels required)



PATH WITH 90 DEGREE TURN



### INSTALLATION AND DELIVERY ACCEPTANCE

- A survey of the site established by the customer and GE will make the decision for the delivery time.
- This survey of the site (a form is made available by GE) is only to check if the apparent conditions of the site allow the equipment to be delivered.
- If the site is not ready, GE can delay the delivery time.

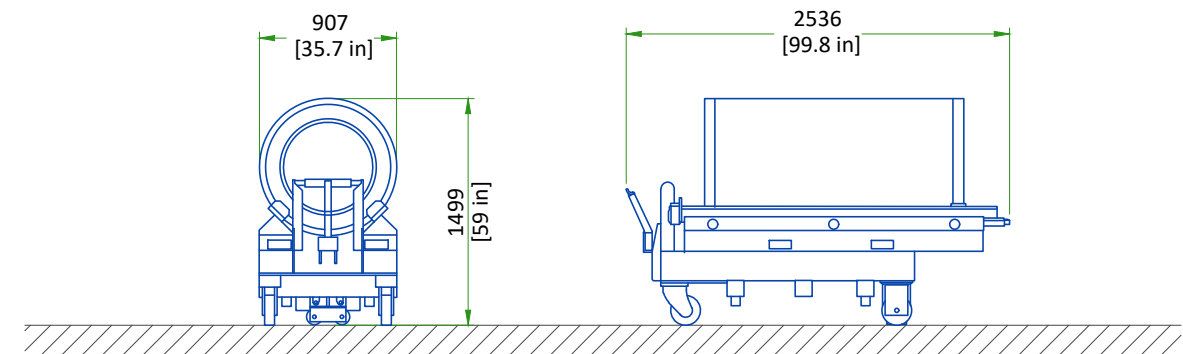
## CRITICAL ITEMS FOR MAGNET DELIVERY

- 24/7 chilled water and 480v power for shield/cryo cooler
- 24/7 120v power for the magnet monitor
- Phone lines for magnet monitoring and emergency use
- Magnet room exhaust fan
- Cryogen venting (if roof hatch, completed within 24 hrs)

This is only a partial list of items required for delivery of the magnet. For a complete checklist refer to the pre-installation manual referenced on cover sheet.

FOR REFERENCE ONLY

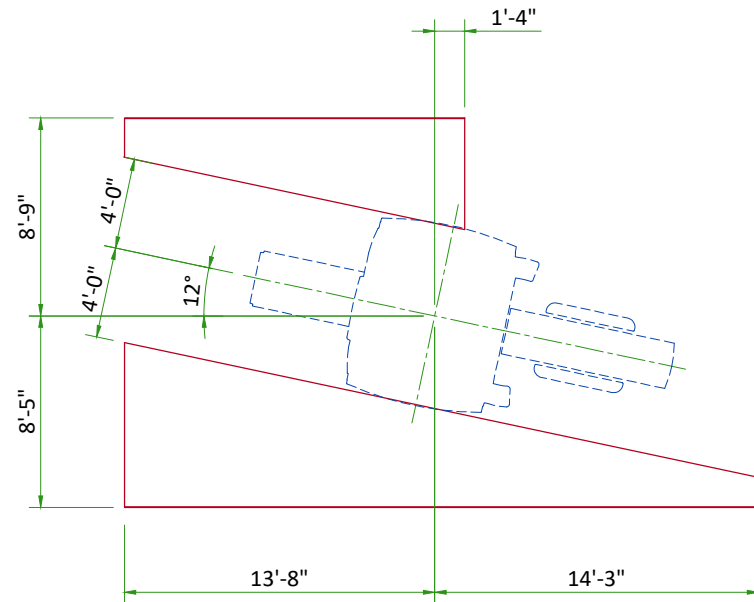
## GRADIENT COIL REPLACEMENT



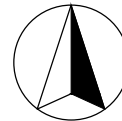
EQUIPMENT	DIMENSIONS LxWxH		WEIGHT		NOTE
	mm	in	kg	lbs	
Replacement XRM gradient coil assembly on a shipping cradle/cart	991x2536x1499	39x99.84x59	1449	3194	Initial gradient coil assembly is shipped installed in the magnet. Shipping/installation cart is used to install replacement coil assembly only.

The weight bearing structure of the site should support any additional weight of the main replacement parts occurring during maintenance of the magnet, throughout the whole lifecycle of the MR.

## SHIELDING PLAN [REFERENCE ONLY-NOT TO SCALE]



All surfaces are 1/4" M36



### ADDITIONAL NOTES

- Attractive force of a magnet on the ceiling and walls of the steel shield will be a maximum of 30% of the shield's weight. Support structure must account for these additional forces.
- Attractive forces on the floor or sub-floor may be sufficient to lift shield's weight. Support structure must prevent this with adhesive or bracing.
- M36 Silicon steel is used in this shield. see shielding requirements sheets for specifications.

## PERFORMANCE STATEMENT FOR MAGNETIC SHIELD DESIGN

GE HEALTHCARE ("GE") provides this magnetic shielding design solely for use with GE's Magnetic Resonance System ("System"). This magnetic shielding design applies solely to the magnetic resonance suite configured as shown in this drawing set.

The magnetic shield, shown in this set, when constructed in strict accordance with this magnetic shield design will:

1. Contain the MRI-generated magnetic induction of 5 gauss within 9'-2" plan north of the magnet's isocenter and
2. Contain the MRI-generated magnetic induction of 5 gauss within 8'-11" plan south of the magnet's isocenter.

("Design Objectives"), subject to and conditioned upon the following:

1. The magnetic field strength measurements are conducted using techniques which account for the effects of the earth's magnetic field and;
2. The magnetic field strength measurements are conducted using techniques which account for magnetic field distortions caused by magnetic materials in the vicinity of the measurement and;
3. Customer demonstrates to GE that the shielding material and fabrications are in strict accordance with GE's design and specifications and;
4. Customer demonstrates to GE that the shielding is installed in strict accordance with GE's design, specifications and requirements and;
5. Customer demonstrates to GE that (i) the System has not been and is not being subjected to improper or extraordinary use, (ii) the System has not been and is not being subjected to improper maintenance, and (iii) Customer has complied with all applicable instructions or recommendations of GE related to the System and magnetic shield; and
6. Customer operates the System at or below its specified field strength.

GE will re-perform the magnetic shielding design services, to the extent that GE determines the design services fail to meet the Design Objectives specified above, provided GE is notified in writing by Customer of such failure within one (1) week after the date of availability of the System for first use, subject to all other terms and conditions of the agreement between GE and Customer for the purchase or lease of the System.

The foregoing sets forth Customer's exclusive remedies and GE's sole liability for claims based on the failure of the magnetic shielding design services to meet the Design Objectives. In no event shall GE be liable for special or consequential damages.

The magnetic field gradients resulting from the magnetic shield's effect on the System's magnet will allow the System's magnet to meet published homogeneity specifications upon completion of required installation procedures.

The final performance of the magnetic shield set forth in this drawing set depends on strict adherence to the construction and material requirements detailed herein. Any deviation from these requirements will degrade shielding effectiveness. For this reason, GE recommends that only established magnetic shielding vendors be used. Vendors should be required to provide documentary evidence to demonstrate that their shielding product complies with GE's construction requirements, material requirements, chemical composition specifications, and annealing specifications; or the material's DC magnetization curve at high induction is equivalent to GE's specification on SH2.. A guarantee that the finished shield will meet the Customer's fringe field containment requirements should be sought from the shielding vendor.

The isogauss contours shown on this drawing set indicate the magnetic fringe field containment which corresponds to the predicted interaction between the System and the magnetic shield design described. GE creates these isogauss contour plots only to predict if the shield design meets the Design Objectives. All other effects such as the superposition of the earth's magnetic field, residual magnetism, and localized field concentration effects, due to ferromagnetic structural elements, are not considered or indicated. The exact location of a particular isogauss contour may differ from that shown due to: (1.) the above stated reasons and (2.) the resolution limits of the mathematical modeling techniques used to derive these results. Note also that for actively shielded Systems, fault conditions may exist where the isogauss contours expand temporarily (refer to your System's Pre-Installation Manual for exact information regarding fault expansions).

The Customer is responsible for the effect of the fringe fields produced by the System's magnet, and is responsible for the coordination of the magnetic shield design into existing or planned facilities, such as foundations/footings and other building components.

The Design Objectives have been formulated by GE from information, both written and verbal, obtained from the Customer, his agents, and/or representatives as part of the MR Site Evaluation process. The final decision on the Design Objectives criteria and the amount of magnetic field containment needed at this site rests solely with the Customer or his designated representatives. Please contact MR Siting/Shielding immediately with any corrections and/or additions related to this magnetic shield design.

GE recommends that your final shield fabrication drawings be forwarded for review. Any deviations from the design specified in this drawing set must be brought to the attention of GE. Please allow up to two weeks for the review process.

Send drawings to your Project Manager as identified on the cover sheet.

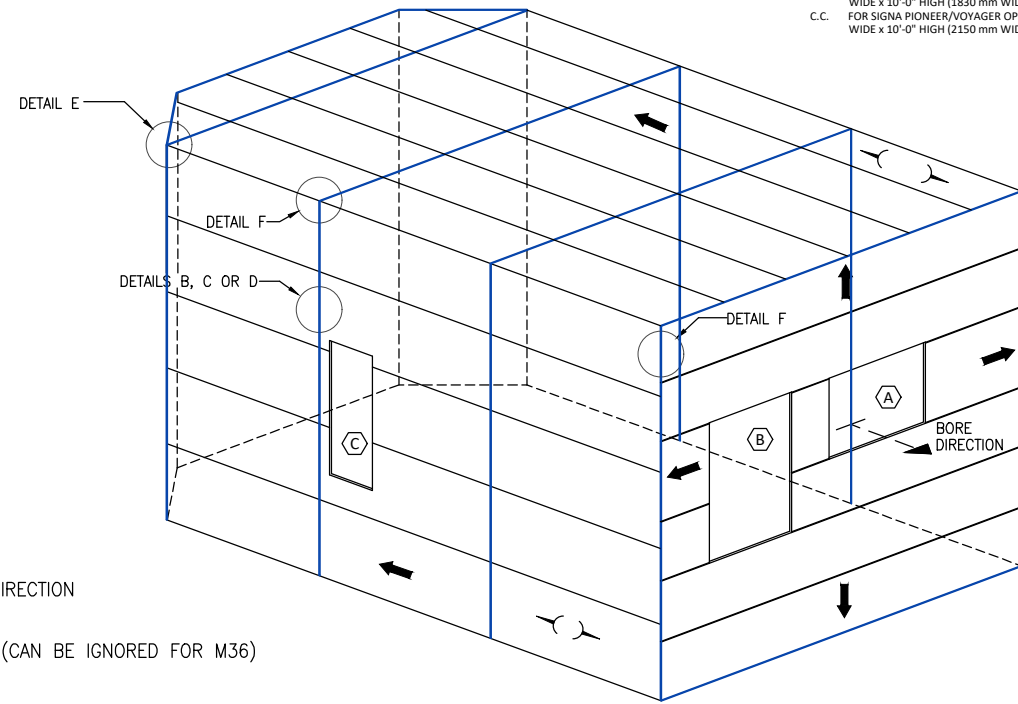
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**FOR REFERENCE ONLY**

# TYPICAL SHIELD - GENERAL VIEW

## TYPICAL SHIELD OPENINGS

- Ⓐ WINDOW 4'-8" WIDE x 4'-2" HIGH (1422 mm WIDE x 1270 mm HIGH)
- Ⓑ DOOR 4'-8" WIDE x 7'-6" HIGH (1422 mm WIDE x 2286 mm HIGH) FOR
- Ⓒ SIGNA 3T, 1.5T PENETRATION PANEL 2'-2" WIDE x 6'-2" HIGH (660 mm WIDE x 1879 mm HIGH)
- C.A. FOR MR 1.5T HDe, SIGNA EXPLORER/CREATOR PENETRATION PANEL 5'-1" WIDE x 6'-7" HIGH (1550 mm WIDE x 2000 mm HIGH)
- C.B. FOR DV 3T AND 1.5T TYPICAL OPENING FOR 2 PENETRATION PANEL 6'-0" WIDE x 10'-0" HIGH (1830 mm WIDE x 3050 mm HIGH)
- C.C. FOR SIGNA PIONEER/VOYAGER OPENING FOR 2 PENETRATION PANEL 7'-2" WIDE x 10'-0" HIGH (2150 mm WIDE x 3050 mm HIGH)

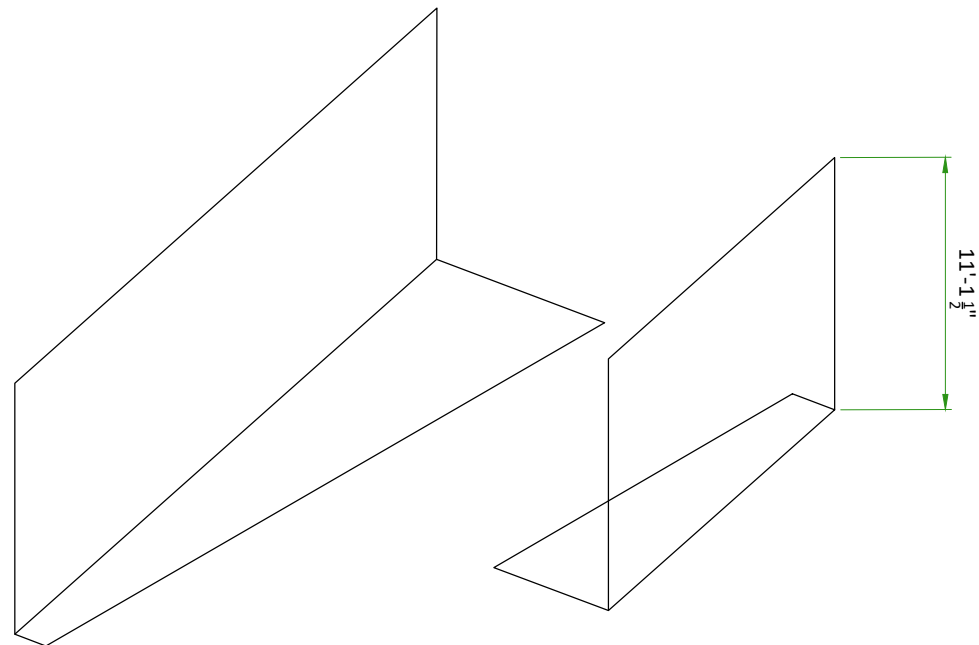


← = MAGNETIC FLUX DIRECTION

↻ = GRAIN DIRECTION (CAN BE IGNORED FOR M36)

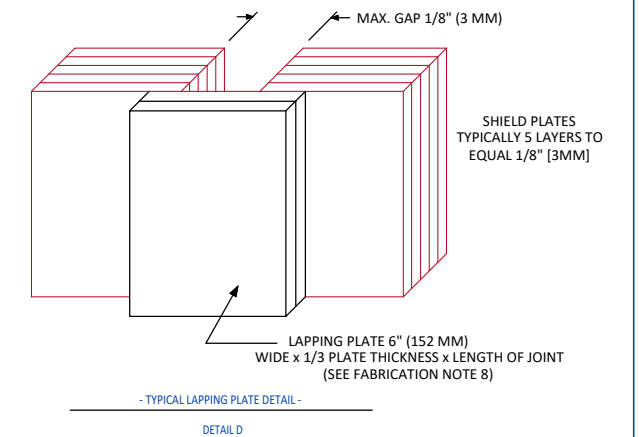
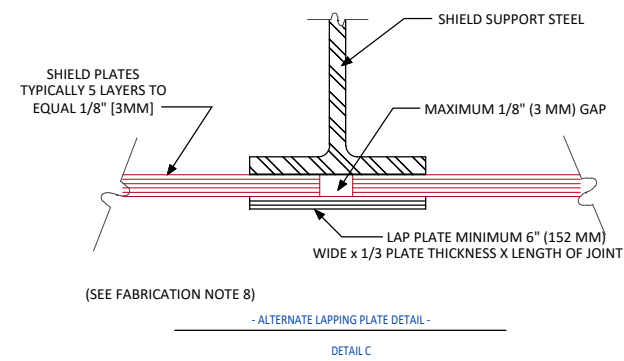
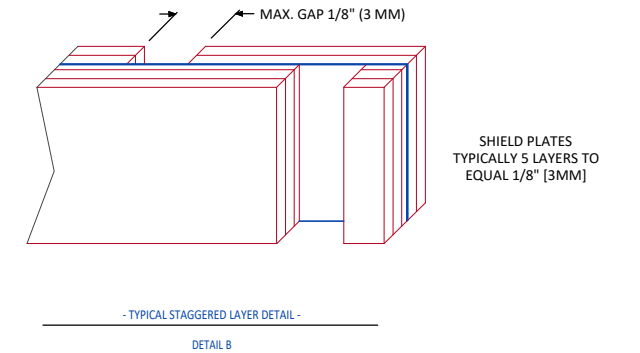
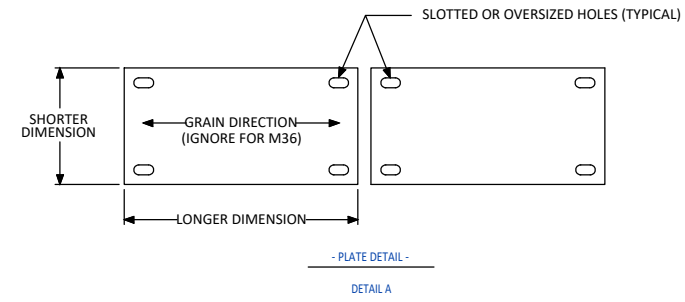
— BOLD LINES INDICATE LOCATIONS FOR REQUIRED LAPPING PLATES (SEE FABRICATION NOTE 7)

# ISOMETRIC DRAWING [REFERENCE ONLY-NOT TO SCALE]

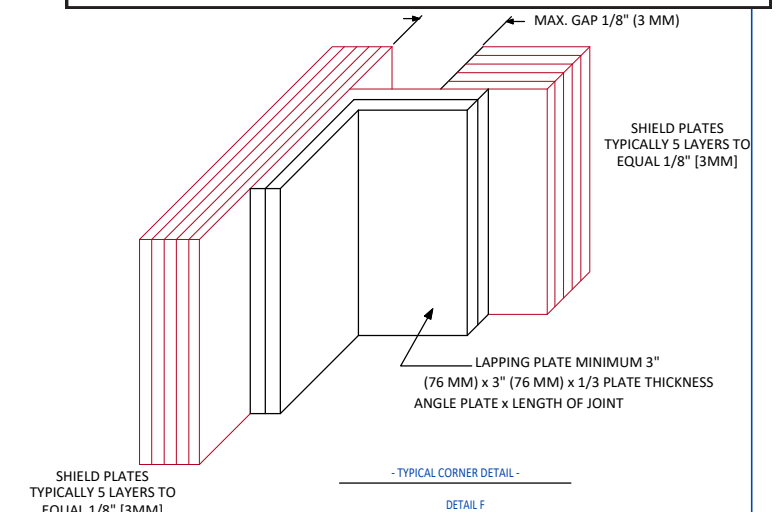
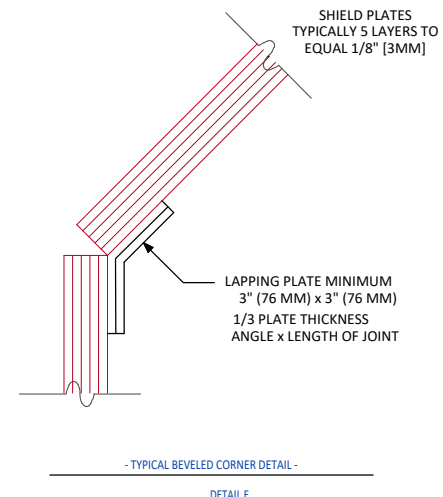


All surfaces are 1/4" M36

# TYPICAL SHIELD - GENERAL VIEW DETAILS



FOR REFERENCE ONLY





# SILICON STEEL MATERIAL REQUIREMENTS

ARMCO DI-MAX M36 (or material with equivalent magnetic properties) CR FP BARE (non coated) non-oriented electrical steel (2.25% maximum silicon content, 0.004% maximum carbon content, 0.65% maximum aluminum content).

- Material must meet all requirements of ASTM A677 for fully-processed non-oriented electrical steel.
- Material must meet or exceed magnetic properties as illustrated in figure 1 when tested per ASTM A596 as sheared with laminations in test specimen half parallel, half transverse to the rolling direction.
- Material must not be handled with electromagnetic equipment.
- Each sheet of material must lie flat under it's own weight.
- Material supplier must provide manufacturers certification with shipment.

**NOTES:**

- Shield thickness is not to scale.
- Magnetic properties of electrical steels are especially sensitive to stress. substantial reductions in magnetic properties can be caused by only a few hundred pounds per square inch. therefore, prevention of stresses due to elastic or plastic deformation during handling is critical.
- Refer to figure 2 for some examples of situations to avoid.
- Each 1/8" (3 mm) shield thickness consists of 5 layers of 24 gauge (0.0250 inch [0.64mm]) M36 steel.

(SILICON-011310)

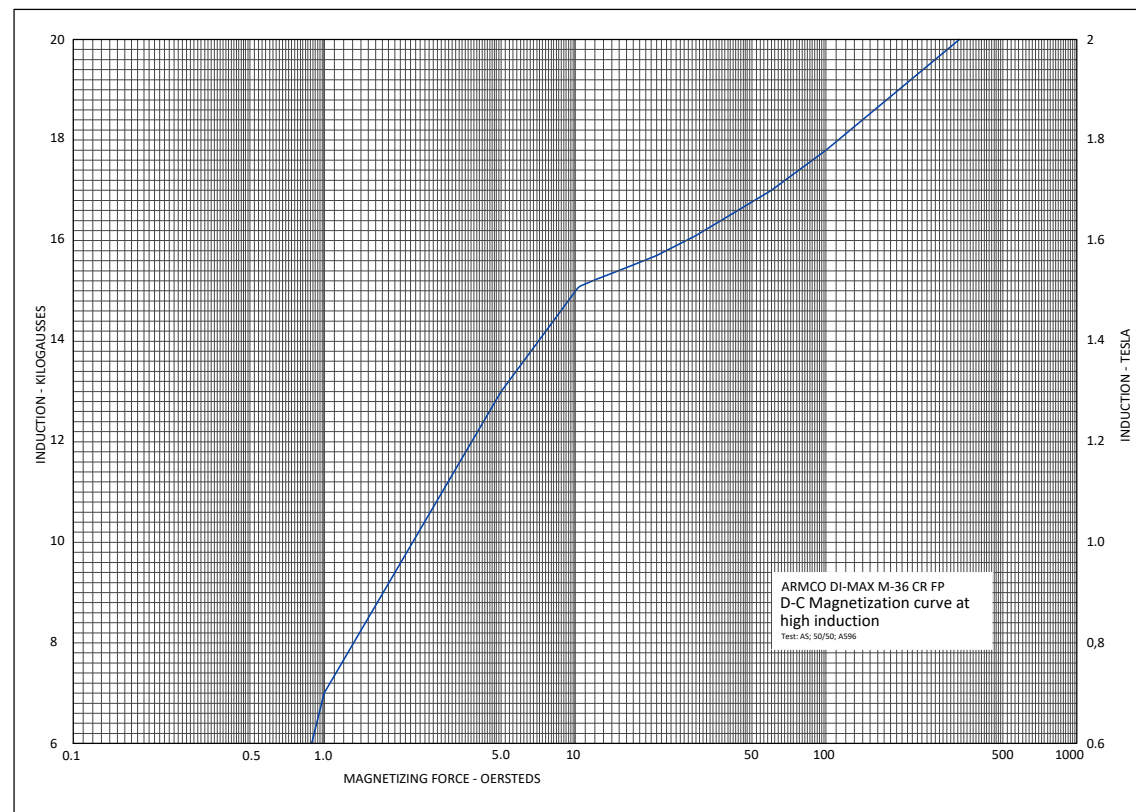
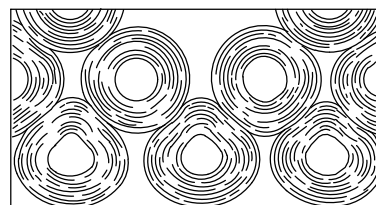


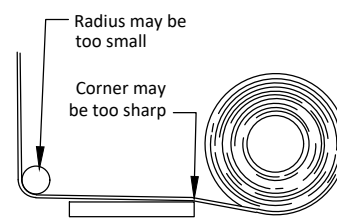
FIGURE 1

Excessive stresses may be produced in electrical steel by improper arrangement of coils in storage, as indicated.



Unintentional introduction of excessive stress in steel during storage of coils.

Improper handling of strip, sheets or long laminations can introduce stress that impair magnetic properties of the steel.



Coil set introduced in handling strip or long laminations.

FIGURE 2

# SHIELD NOTES

## MAGNETIC SHIELD CONSTRUCTION REQUIREMENTS

The actual performance of the magnetic shield depends upon strict adherence to the following requirements.

### GENERAL

1. The design of the shield support system is the responsibility of the customer's architect, structural engineer, and shield vendor.
2. The magnetic shield design must be adhered to exactly. Any deviation from dimensional design, fabrication technique or material specification must be assessed and documented by GE MR Siting.
3. Building and shield support structures should be outside of the steel plates to preclude detrimental effects on homogeneity. If it is absolutely necessary to have support structure on the inside of the shield, a homogeneity analysis must be performed and documented by GE MR siting.
4. For all 1.5T and 3T MR systems, use of non-magnetic materials for concrete floor reinforcement is recommended, unless a homogeneity analysis has been performed and documented by GE MR Siting. For older 1.5T systems with the Magnishield option, signa 0.5T systems, MR Max systems and Vectra systems, conventional reinforcing and structural members are acceptable.
5. A secondary plate must be magnetically isolated from the primary shield. The use of non-magnetic structural members such as aluminum or non-magnetic stainless steel is acceptable.
6. If the magnetic shield is installed inside an RF shield, both the shield and its support system must be isolated from ground by 1,000 ohms or greater and meet all the GE RF room requirements as specified in the appropriate GE pre-installation manual.
7. The minimum finished floor to finished ceiling clearance in the magnet room is shown on sheet A2. Clearance dimensions do not include space required for the magnetic shield, RF shield, shield structure, and finished ceiling materials.
8. Locations of the penetration panel, window, and door openings are established on the final layout. Changes must be documented by GE MR Siting and Planning.
9. Penetration panel mounting details are specified in the appropriate GE site planning direction.
10. Consult GE MR Siting for guidance on any issues relating to magnetic shielding.
11. There must be a minimum of 8 inch [200mm] between the magnetic shield and the area where the magnetic field is being reduced. For example if a hallway has a 5 gauss restriction goal, the magnetic shield should be positioned 8 inch [200mm] inside the hallway surface. Larger buffer spaces are preferred but 8 inch [200mm] is the recommended minimum.
12. If the magnetic shield is supported by the parent room structure, the parent room structure should be wood/concrete/aluminum whenever possible. If the parent wall structure is steel, then the magnetic shield needs to be decoupled from the steel studs by a minimum of 5/8 inch [16mm] gypboard, plywood, furring, or other non-magnetic media.
13. If the magnetic shield is supported inside the RF structure, care must be taken to avoid loose metal to metal contacts or dissimilar metal contacts. Refer to the RF section of the pre-installation manual for all requirements. Magnetic decoupling media may also be needed if the magnetic shield is attached directly to an RF shield that is primarily steel.

FOR REFERENCE ONLY

### FABRICATION

1. Magnetic shield ceilings, floors, walls, etc. Will consist of multiple layers to make of the design's required thickness.
2. Slotted or oversized bolt holes are recommended to assure adequate play for positioning plates tightly together. Refer to detail a.
3. If multiple layers of steel are used, some lapping plates can be eliminated by staggering plate separations. Refer to detail B. This is the recommended method for multiple layers.
4. If layers are not staggered or a single layer of the required thickness is used, lapping plate must be used to cover plate separation. Lapping plate is required at each corner, plate separations perpendicular to the magnet bore's axis. This include all vertical seams in the sidewalls, all cross seams in floor and ceiling, all horizontal and vertical seams in the front and rear surfaces and all corners where a front or rear surface meet any other surface. Refer to details C, D, E, F, and shield isometric.
5. Gaps in the shield which are perpendicular to the flux path are critical and should be kept to a minimum. Maximum separation between plates is 1/8 inch (3mm).
6. Hole diameter of 8" [200mm] or less, when separated from another hole by a minimum of 3 times the diameter of the hole is allowed as needed. Holes for cryogen venting, HVAC, etc. Must be assessed and documented by GE MR Siting.
7. Angled joints do not need to have beveled mating edges. Refer to detail E.
8. When lapping plate material is required, it should extend at least 3" [76mm] to each side of the separation, and should have a total minimum thickness of 1/3 the thickness of the shield thickness.
9. Any separation between plates which exceed 1/8" [3mm] cannot be corrected by placing a lapping plate over the separation or using full seam welds across the separation. Corrections for this situation must be assessed and documented by GE MR Siting.
10. Lapping plate can be attached by tack welding or bolting.
11. Shield plates are to be free of loose scale. Failure to remove scale can result in loose scale and steel particles becoming lodged in the magnet. The preferred method for removal of scale is sandblasting. Removal of scale using wire brush is permitted. Shot blasting is prohibited.
12. Shield plates must be rigidly supported to prevent movement resulting from air pressure or other environmentally induced changes which can alter the magnet's homogeneity or systems performance.
13. Shield plate must be well anchored to the support structure by plug welding or bolting.
14. Full seam welding is not recommended for attaching shield plates to support structure or adjacent shield plates.
15. Minimum penetration full seam welds are allowed when the magnetic shield also serves as the RF shield.
16. Full seam welding is not allowed on silicon steel sheets.
17. Minimize the need for flame cutting of steel plate after annealing, as material's magnetic properties can be altered as a result of stress induced by this process.
18. Loose ferrous components become dangerous projectiles when the magnet is energized.

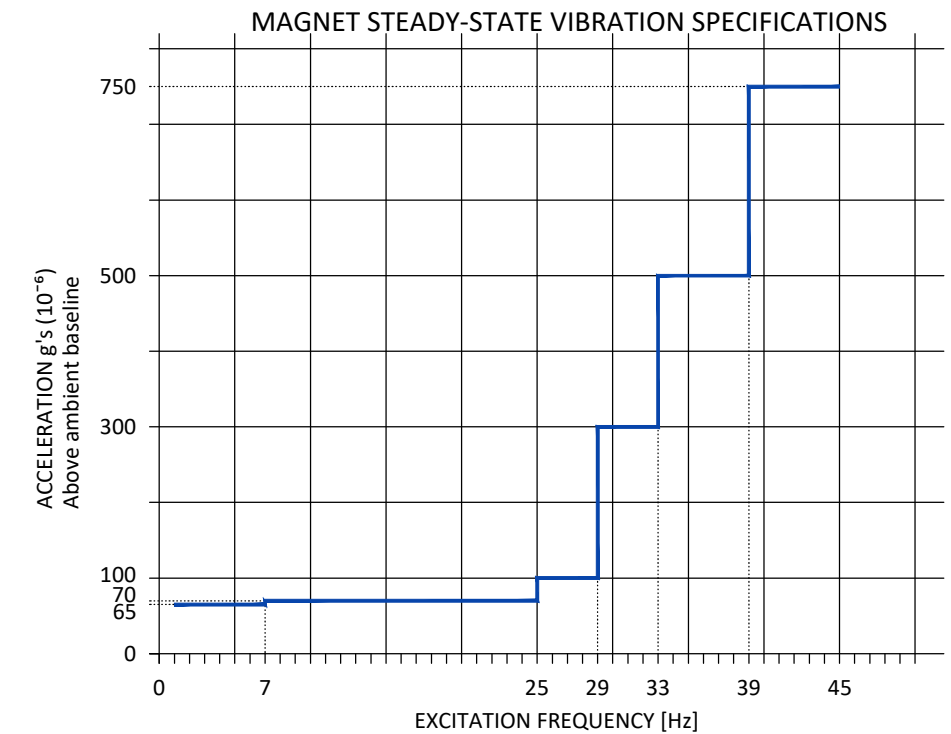
## STRUCTURAL NOTES

- All units that are wall mounted or wall supported are to be provided with supports where necessary. Wall supports are to be supplied and installed by the customer or his contractors.
- Dimensions are to finished surfaces of room.
- Certain mr procedures require an extremely stable environment to achieve high resolution image quality. Vibration is known to introduce field instabilities into the imaging system. The vibration effects on image quality can be minimized during the initial site planning of the mr suite by minimizing the vibration environment. See [PROXIMITY LIMITS](#), [PATIENT TABLE DOCK ANCHOR MOUNTING REQUIREMENTS AND VIBROACOUSTIC DAMPENING KIT](#) details for additional information.
- Standard steel studs, nails, screws, conduit, piping, drains and other hardware are acceptable if properly secured. Any loose steel objects can be violently accelerated into the bore of the magnet. Careful thought should be given to the selection of light fixtures, cabinets, wall decorations, etc. To minimize this potential hazard. For safety, all removable items within the magnet room such as faucet handles, drain covers, switch box cover plates, light fixture components, mounting screws, etc. Must be non-magnetic. If you have a specific question about material, bring it to the attention of your GE project manager of installations.
- Floor levelness refer to [MAGNET ROOM FLOOR SPECIFICATIONS DETAIL](#), this floor levelness requirement is important for accurate patient table docking.
- Non-movable steel such as wall studs or hvac components will produce negligible effect on the active shield magnet.
- Customers contractor must provide all penetrations in post tension floors.
- Customers contractor must provide and install any non-standard anchoring. Documents for standard anchoring methods are included with GE equipment drawings for geographic areas that require such documentation.
- Customers contractor must provide and install hardware for "through the floor" anchoring and/or any bracing under access floors. This contractor must also provide floor drilling that cannot be completed because of an obstruction encountered while drilling by the GE installer such as rebar etc.
- Customers contractor to provide and install appropriate supports for the storage of excess cables.
- It is the customer's responsibility to perform any floor or wall penetrations that may be required. The customer is also responsible for ensuring that no subsurface utilities (e.g., electrical or any other form of wiring, conduits, piping, duct work or structural supports (i.e. post tension cables or rebar)) will interfere or come in contact with subsurface penetration operations (e.g. drilling and installation of anchors/screws) performed during the installation process. To ensure worker safety, GE installers will perform surface penetration operations only after the customer's validation and completion of the "GE surface penetration permit"

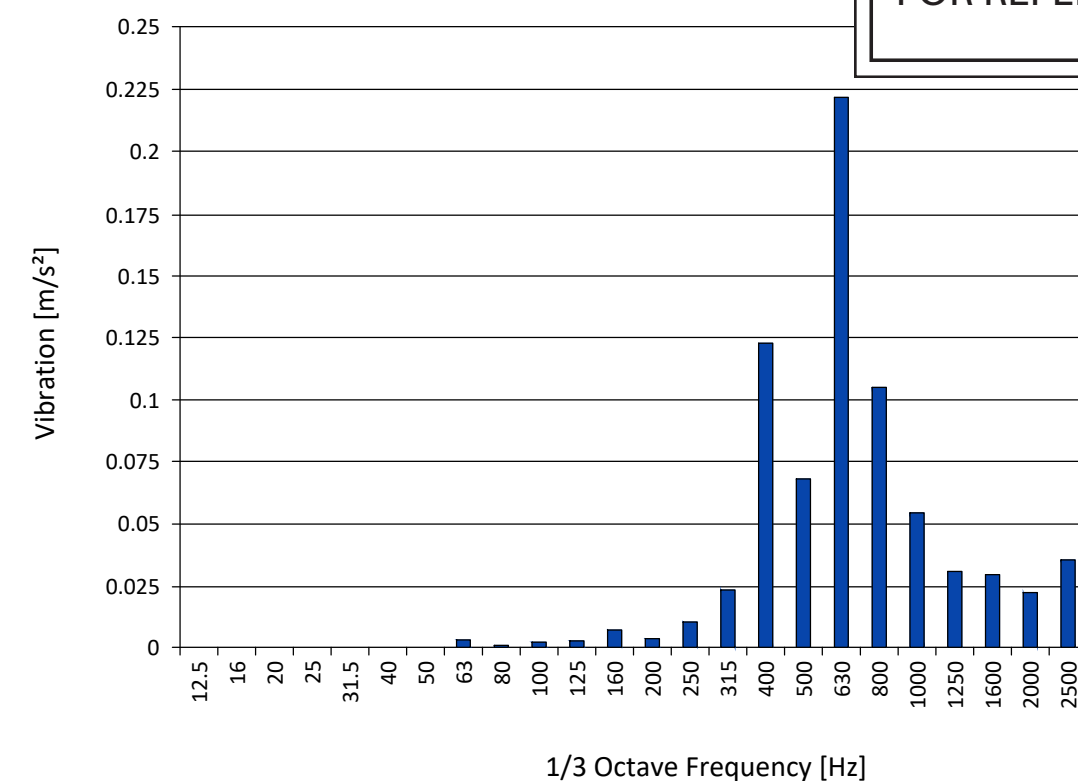
## VIBRATION SPECIFICATIONS

Excessive vibration can affect MR image quality. Vibration testing must be performed early in the site planning process to ensure vibration is minimized. Both steady state vibration (exhaust fans, air conditioners, pumps, etc.) and transient vibrations (traffic, pedestrians, door slamming, etc.) must be assessed. The Magnet cannot be directly isolated from vibration. Any vibration issue must be resolved at the source.

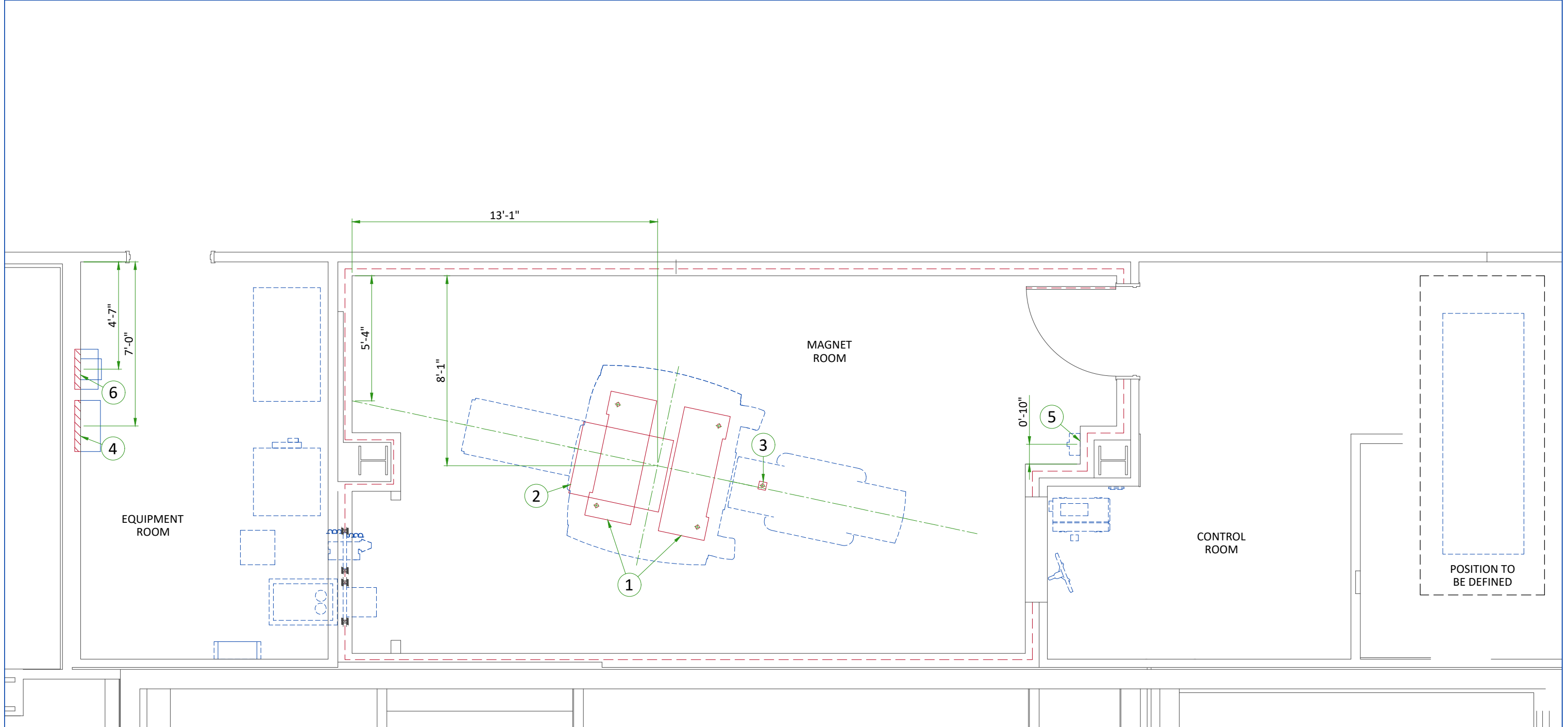
Transient vibration levels above the specified limits in the MR Site Vibration Test Guidelines must be analyzed. Any transient vibration that causes vibration to exceed the steady-state level must be mitigated.



## VIBRATION TRANSMITTED THROUGH VIBROACOUSTIC MAT

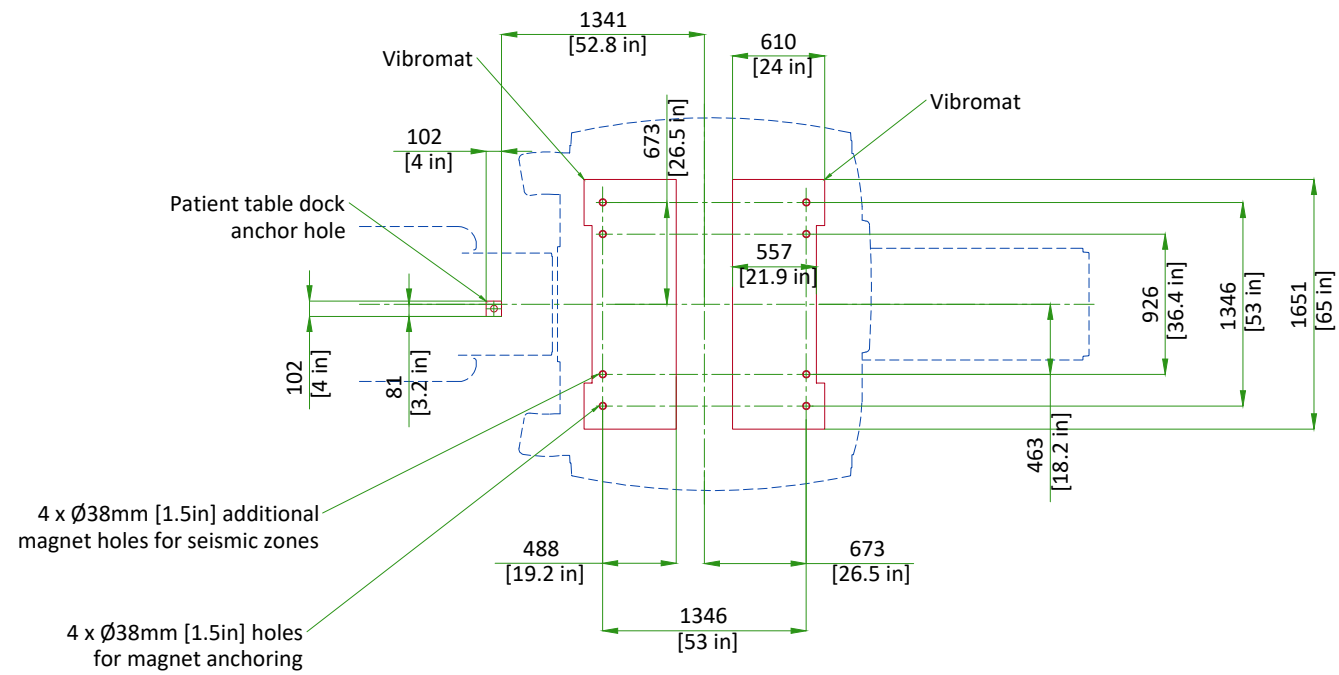


ITEM	DESCRIPTION
(GE SUPPLIED / CONTRACTOR INSTALLED)	
1	Vibroacoustic dampening kit (see floor structural detail)
2	Magnet curtain kit
(CONTRACTOR SUPPLIED & INSTALLED)	
3	Patient table dock anchoring
4	Structural wall backing for Main Disconnect Panel
5	Structural wall backing for Magnet Rundown Unit
6	Structural wall backing for DC lighting



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## MAGNET ON VIBROACOUSTIC DAMPENING KIT "VIBROMAT"

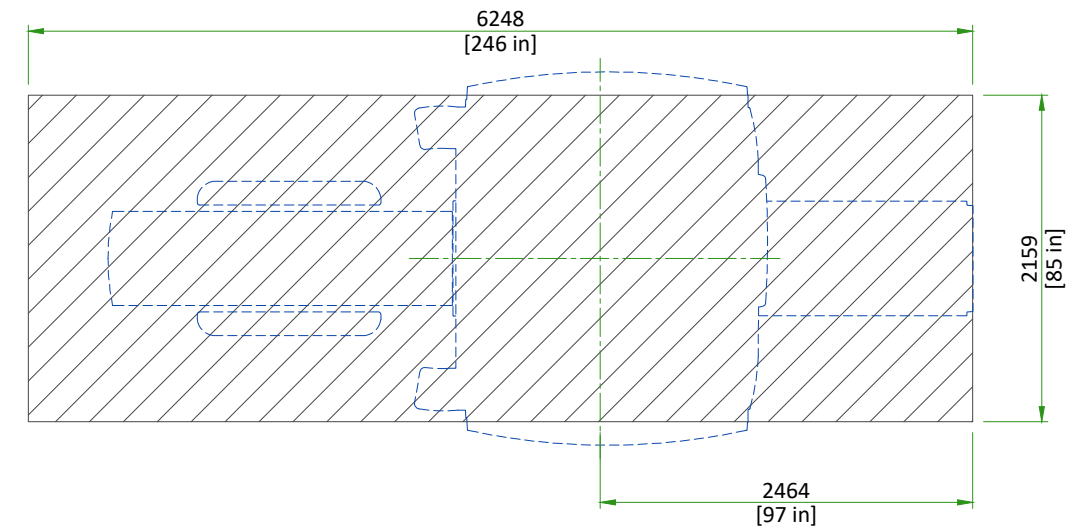


VibroAcoustic Mat weight:  
116 kg [255 lbs] (each)

NOT TO SCALE

## MAGNET ROOM FLOOR SPECIFICATIONS

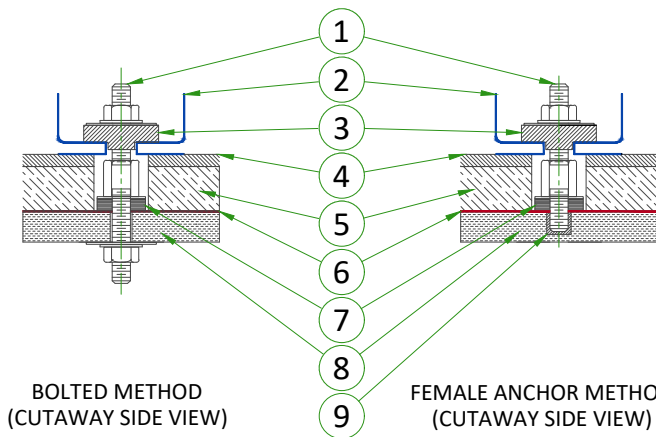
Magnet, Enclosure, and Patient Table areas must be flat and level within **3 mm [0.12in]** within the shaded area shown.



The finished floor must support the weight of all components (e.g., patient table, gradient coil replacement cart) throughout operation and service life.

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## PATIENT TABLE DOCK ANCHOR MOUNTING REQUIREMENTS



- The RF Shield vendor must design and install the dock anchor bolt
- The dock anchor hole must be drilled **after** the Magnet is installed
- The dock anchor must not contact floor rebar or other structural steel
- The dock anchor must electrically contact the RF shield at point of entry
- The RF shield vendor must perform a pull test on the anchor (equal to the clamping force).

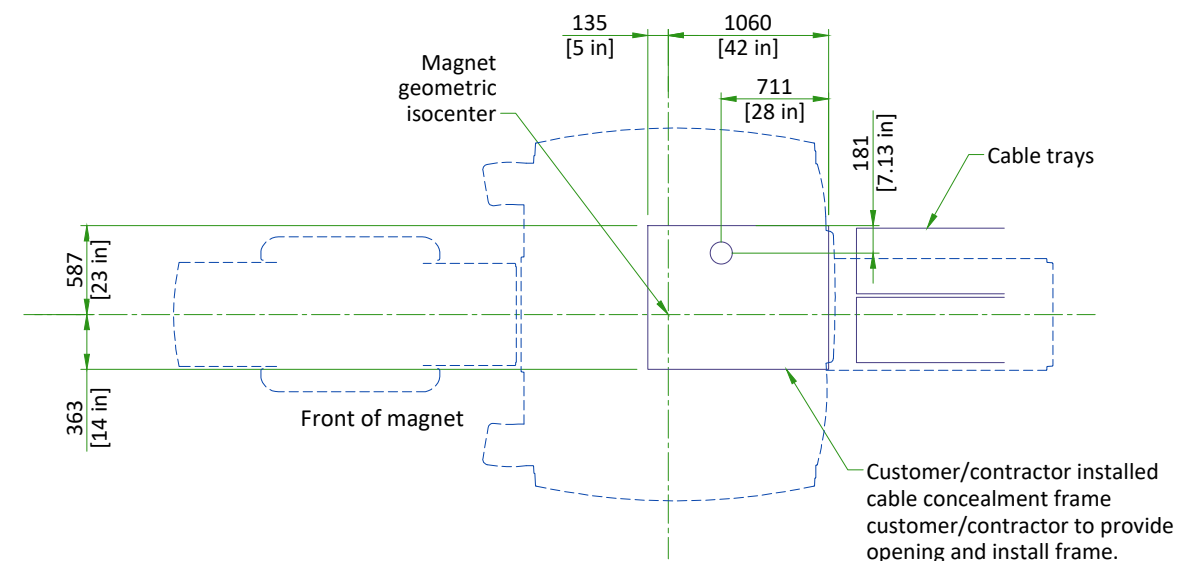
The dock anchor properties must comply with the following requirements:

- Anchors must be two-part assembly (male/female)
- Female side must be expansion- or epoxy-type
- Male side must be a bolt or threaded rod with appropriate-sized nut (bolt or rod must be removable - not epoxied or cemented in place)
- Anchors must be electrically conductive
- Anchors must be non-magnetic
- Anchors must not induce galvanic corrosion with the RF shield
- Anchors must be commercially procured
- The anchor rod hole clearance in the table frame anchor base is 11mm [0.43 in]. The anchor rod diameter must be sized appropriately.
- Anchors must meet the following clamping force: 2,669 N [600 lb]
- The anchor rod must extend 60 mm ± 13 mm [2.25 in ± 0.5 in] above the finished floor
- The anchor rod must be less than 152 mm [6 in] in total length (length above the floor plus embedded length)
- If underside of deck is metallic, then insulating bushing must be added to through bolt hardware to prevent grounding of shield at this point.

- Removable Anchor Rod (Male insert)
- Dock
- Clamp bracket
- Finished floor
- Filler Board or Grout
- RF Shield
- Conductive Fibrous Washer (RF seal)
- Concrete
- Female Anchor Insert

NOT TO SCALE

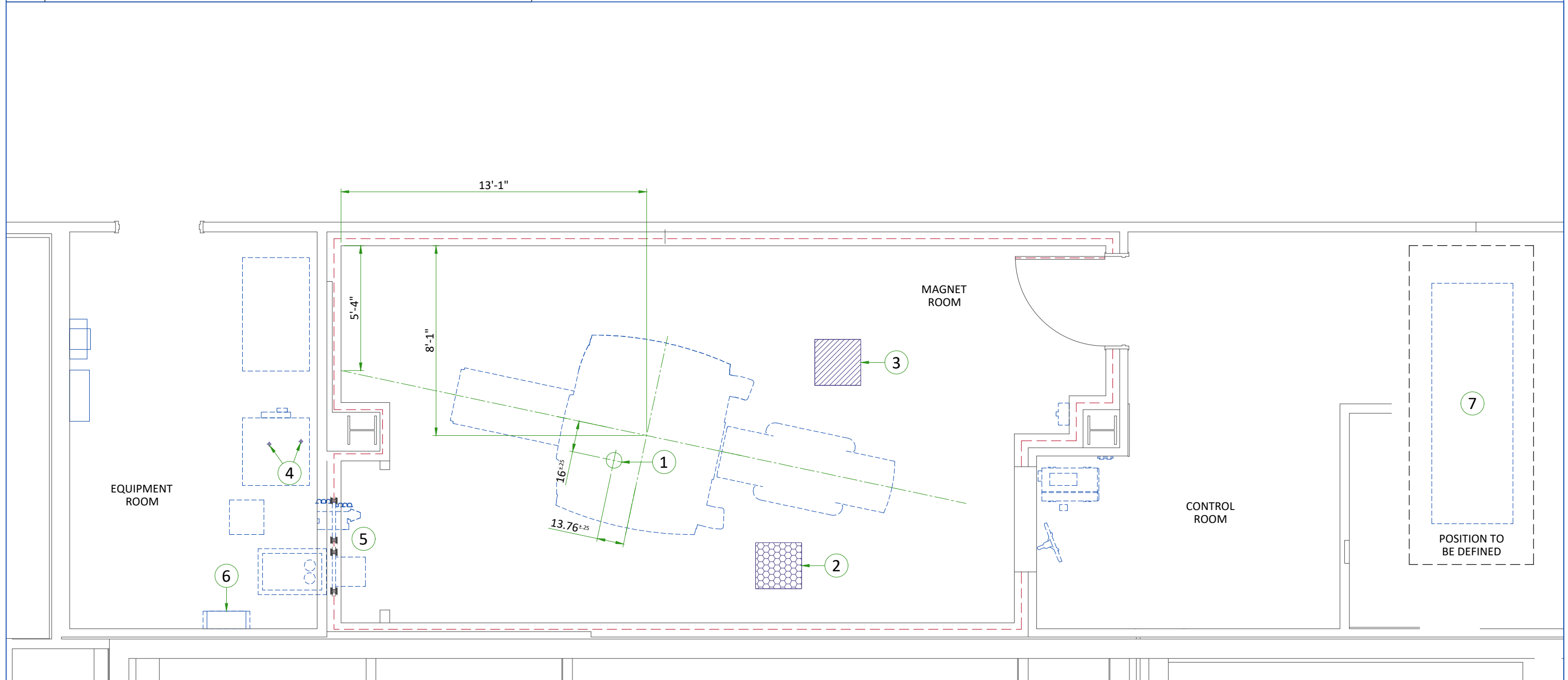
## CABLE CONCEALMENT



NOTE:

- This drawing is to be used only as a design intent document. refer to ge installation manual for tray install. actual tray installation may be site dependent.
- This drawing not to scale

ITEM	DESCRIPTION	MECHANICAL/PLUMBING NOTES
1	Cryogen vent (200mm [8"] O.D.)	<ul style="list-style-type: none"> <li>• All piping, fittings, supports, hoses, clamps, ventilation systems, etc. are to be supplied and installed by the customer or his contractors.</li> <li>• For complete design and requirements, specifications and guidelines refer to the pre-installation manual: system cooling, cryogen venting, waveguides and exhaust venting.</li> <li>• An emergency water cooling back-up supply is recommended for continuous cryogen compressor operation. if using an open loop back-up design, ensure a drain is provided. please refer to the pre-install manual for optional back-up coolant supply requirements</li> </ul>
2	Emergency exhaust vent - refer to magnet room vent requirements (position to be defined)	
3	Pressure equalization vent - refer to magnet room vent requirements (position in ceiling to be defined)	
4	38mm [1.5"] NPT Male connectors, at 2.1m [82.67"] above floor, (2) 38mm [1.5"] copper lines (insulated) and (2) shut off valves. refer to chilled water block diagram	
5	Closet must allow free air exchange of 400 CFM between magnet room and closet	
6	Provide as needed - low pressure rubber multipurpose hose, inside dia. 1/2" working pressure range: 250 to 499 PSI - refer to the manual city water back-up system detail	
7	(2) 50mm [2"] I.D. High pressure hoses and (2) 50mm [2"] to 38mm [1.5"] Reducers	



FOR REFERENCE ONLY



# TEMPERATURE AND HUMIDITY SPECIFICATIONS

## IN-USE CONDITIONS

	MAGNET ROOM			CONTROL ROOM			EQUIPMENT ROOM		
Temperature	Range			Range			Range		
	15 to 21°C			15 to 32°C			15 to 32°C		
59 to 69.8°F			59 to 89.6°F			59 to 89.6°F			
Temperature gradient	± 3°C/h			± 3°C/h			± 3°C/h		
	± 5°F/h			± 5°F/h			± 5°F/h		
Relative humidity (1)	30% to 60%			30% to 70%			30% to 70%		
Humidity gradient	≤ 5%/h			≤ 5%/h			≤ 5%/h		
System heat dissipation	Stand by	Average	Max	Stand by	Average	Max	Stand by	Average	Max
	1.01kW	1.8kW	3.15kW	1.46kW	1.46kW	5.79kW	6.87kW	13.05kW	
	3450 btu	6142 btu	10748 btu	4947 btu	4947 btu	19769 btu	23225 btu	44523 btu	

NOTE  
Maximum ambient temperature for the Equipment room at inlet is derated by 1°C per 300 m (984 ft) above 2000 m (6562 ft) (not to exceed 2600 m [8530 ft]).

## AIR EXCHANGE

According to local standards.

NOTE  
In case of using air conditioning systems or chilled water piping that have a risk of water leakage it is recommended not to install it above electric equipment or to take measures to protect the equipment from dropping water.

# HEAT DISSIPATION DETAILS

DESCRIPTION	ROOM	IDLE		AVERAGE		MAX	
		W	btu	W	btu	W	btu
Magnet (MAG) and Patient Table (PT)	Magnet	561	1915	1200	4095	2400	8189
Blower Box (MG6)	Magnet	450	1535	450	1535	450	1535
Penetration Panel Cabinet (PEN)	Magnet	0	0	150	512	300	1024
Penetration Panel Cabinet (PEN)	Equipment	1568	5349	1568	5349	3135	10697
Secondary Penetration Wall (SPW)	Magnet/Equipment	0	0	0	0	0	0
Main Disconnect Panel (MDP)	Equipment	132	450	132	450	264	901
Power, Gradient, RF Cabinet (PGR)	Equipment	2500	8530	3068	10470	6137	20940
Cryocooler Compressor (CRY)	Equipment	500	1706	500	1706	500	1706
Heat Exchanger Cabinet (HEC)	Equipment	500	1706	500	1706	1000	3412
Magnet Monitor (MON)	Equipment	240	819	240	819	240	819
Operator Workspace equipment (OW)	Control	1450	4947	1450	4947	1450	4947
<b>OPTIONS</b>							
Multi-Nuclear Spectroscopy Cabinet (MNS)	Equipment	7205	24584	7205	24584	7205	24584
BrainWave HW Lite Cabinet (BW)	Equipment	685	2337	685	2337	685	2337
BrainWave HW Lite Cabinet (BW) with options	Equipment	815	2781	815	2781	815	2781
CADstream	Equipment	354	1209	799	2725	1773	6049
MR Elastography (MRE)	Equipment	141	480	141	480	141	480

# MAGNET ROOM VENTING REQUIREMENTS

## HVAC VENT REQUIREMENTS

- HVAC vendor must comply with Magnet room temperature and humidity specifications and RF shielding specifications.
- RF Shield vendor must install open pipe or honeycomb HVAC waveguides.
- All serviceable parts in the Magnet room (e.g.: diffusers) must be non-magnetic.
- Waveguides must be nonmagnetic and electrically isolated.
- Incoming air must contain at least **5% air** from outside the Magnet room (inside or outside the facility) to displace residual helium.

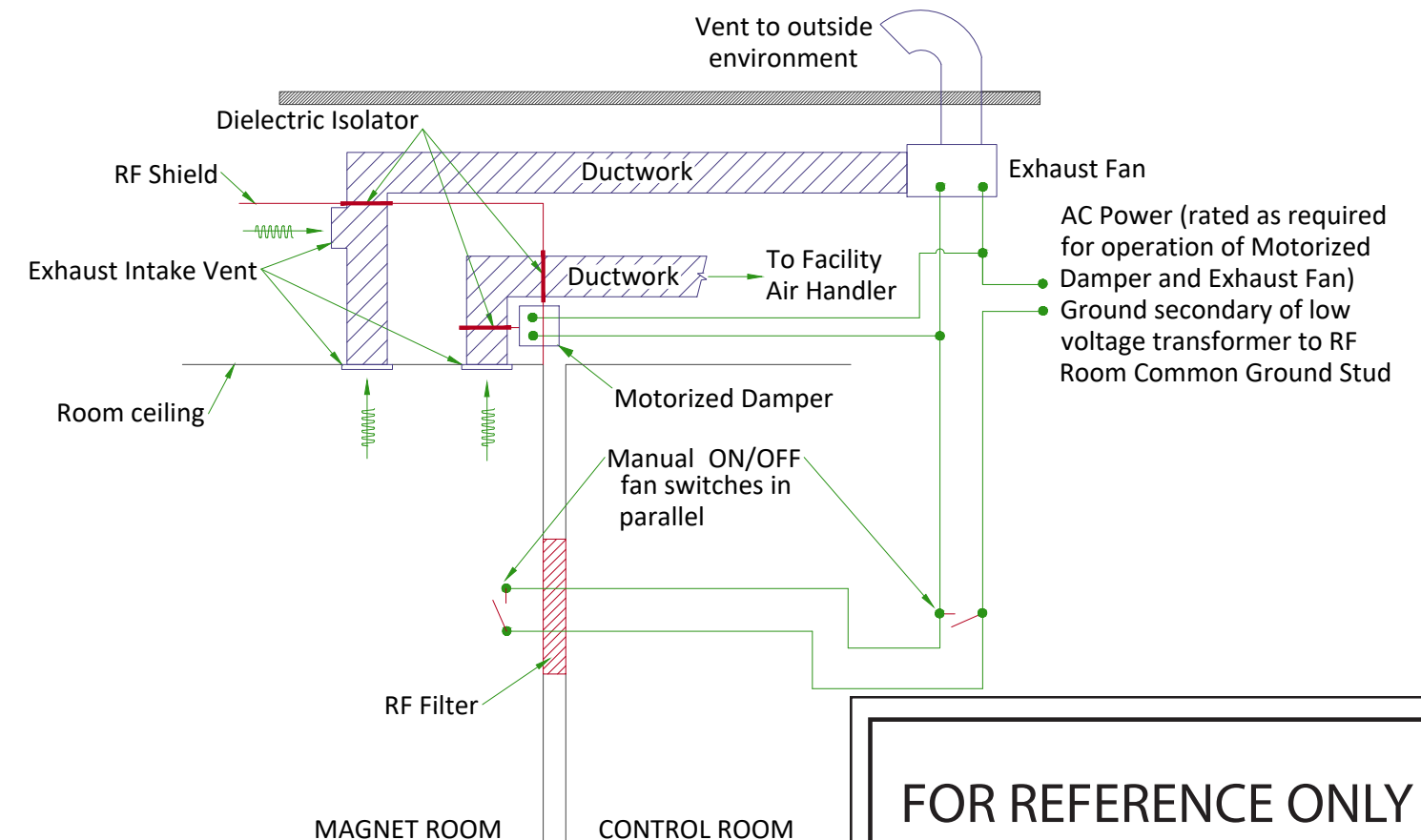
## EMERGENCY VENT REQUIREMENT

- Exhaust vent system is supplied by the customer.
- All items within the RF enclosure must be non-magnetic.
- The exhaust vent system must be tested and operational before the magnet is installed.
- The exhaust intake vent must be located near the magnet cryogenic vent at the highest point on the finished or drop ceiling.
- The Magnet room exhaust fan and exhaust intake vent must have a capacity of at least **1200 CFM (34 m³/min)** with a minimum of **12 room air exchanges per hour**.
- The exhaust fan must be placed above RF shielding located outside 10 gauss (1mT) and with appropriate waveguide.
- The system must have a manual exhaust fan switch near the Operator Workspace and in the Magnet room near the door (the switches must be connected in parallel).
- All system components must be accessible for customer inspection, cleaning and maintenance

## PRESSURE VENT REQUIREMENT

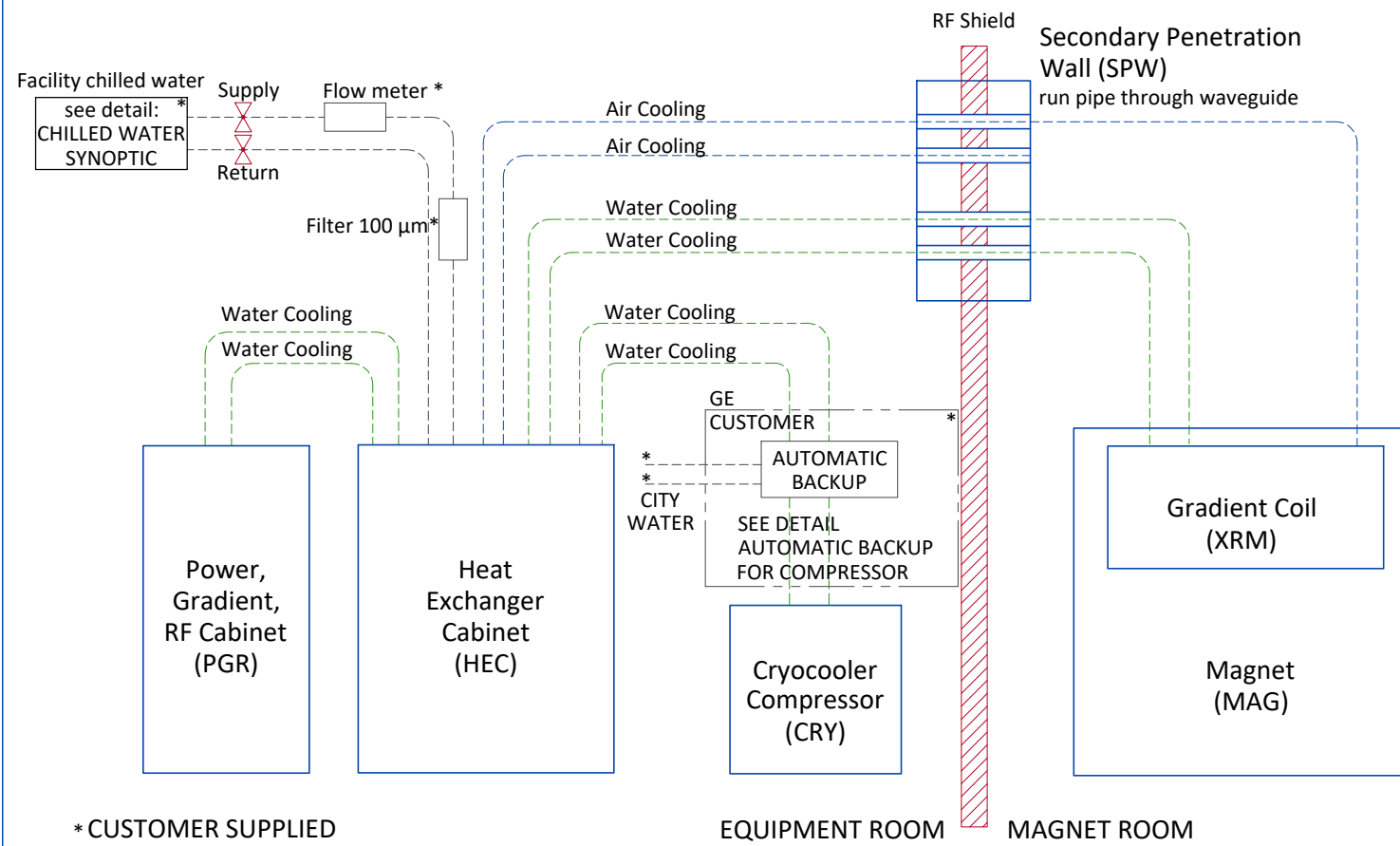
- A **pressure equalizing vent is required** in the magnet room ceiling or in the wall, at the highest point possible.
  - The **vent minimum size must be (610 mm x 610 mm [24 in x 24 in])** or equivalent.
  - The pressure equalization vent must be located so any Helium gas is not vented into occupied areas.
- Note: Location may affect acoustic noise transmission into occupied spaces.

# MAGNET ROOM EXHAUST FAN SCHEMATIC



**FOR REFERENCE ONLY**

## CHILLED WATER BLOCK DIAGRAM

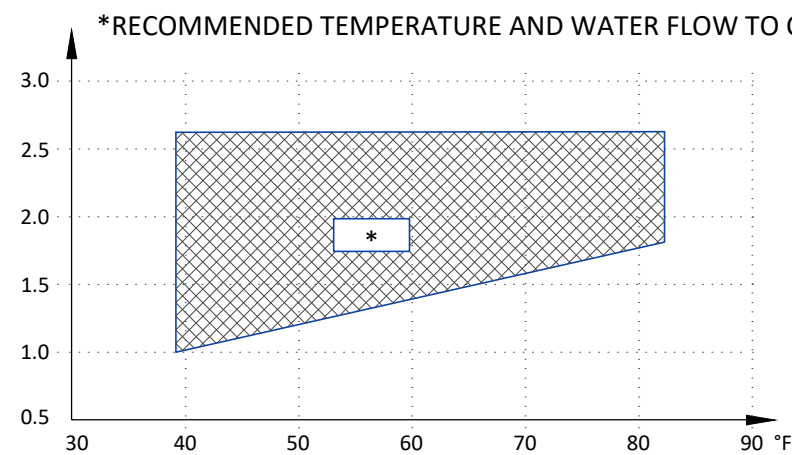


## CHILLED WATER SPECIFICATIONS

PARAMETER		REQUIREMENTS	
Chiller size		Minimum 70 kW	
Inlet temperature		42.8 to 53.6°F (6 to 12°C) measured at the inlet to the HEC	
Hose connections to the HEC (supplied by customer)		1.5 inch (38.1 mm) male NPT	
		<b>MINIMUM FLOW</b> 30 gpm (114 l/min)	<b>MAXIMUM FLOW</b> 35 gpm (132 l/min)
Pressure drop in HEC Cabinet	40% propylene glycol, 60% water	34.8 psi (2.4 bars)	47.8 psi (3.3 bars)
Availability		Continuous	
Antifreeze		no more than 40% propylene glycol	
Temperature rise at minimum flow		17.3°F (9.6°C) with 40% propylene glycol-water 3730J/(kgK) specific heat, 1021kg/m <sup>3</sup> density, 70kW heat	
Temperature rise at maximum flow		15.1°F (8.4°C) with 40% propylene glycol-water 3730J/(kgK) specific heat, 1021kg/m <sup>3</sup> density, 70kW heat	
Maximum inlet pressure to HEC		87 psi (6 bar)	
Minimum continuous heat load		7.5 kW	
Hoses to be provided by customer		1.5 inch (38.1 mm) minimum hose inside diameter	
pH level		6.5 to 8.2 at 77°F (25°C)	
Total hardness		Less than 200 ppm	
Suspended matter		Less than 10 ppm	
Particle size		Less than 100 micron	
Facility filter		100 micron or smaller with a field-changeable filter	
Condensation protection		Facility plumbing to the HEC must be properly routed and insulated to prevent equipment damage or safety hazards	

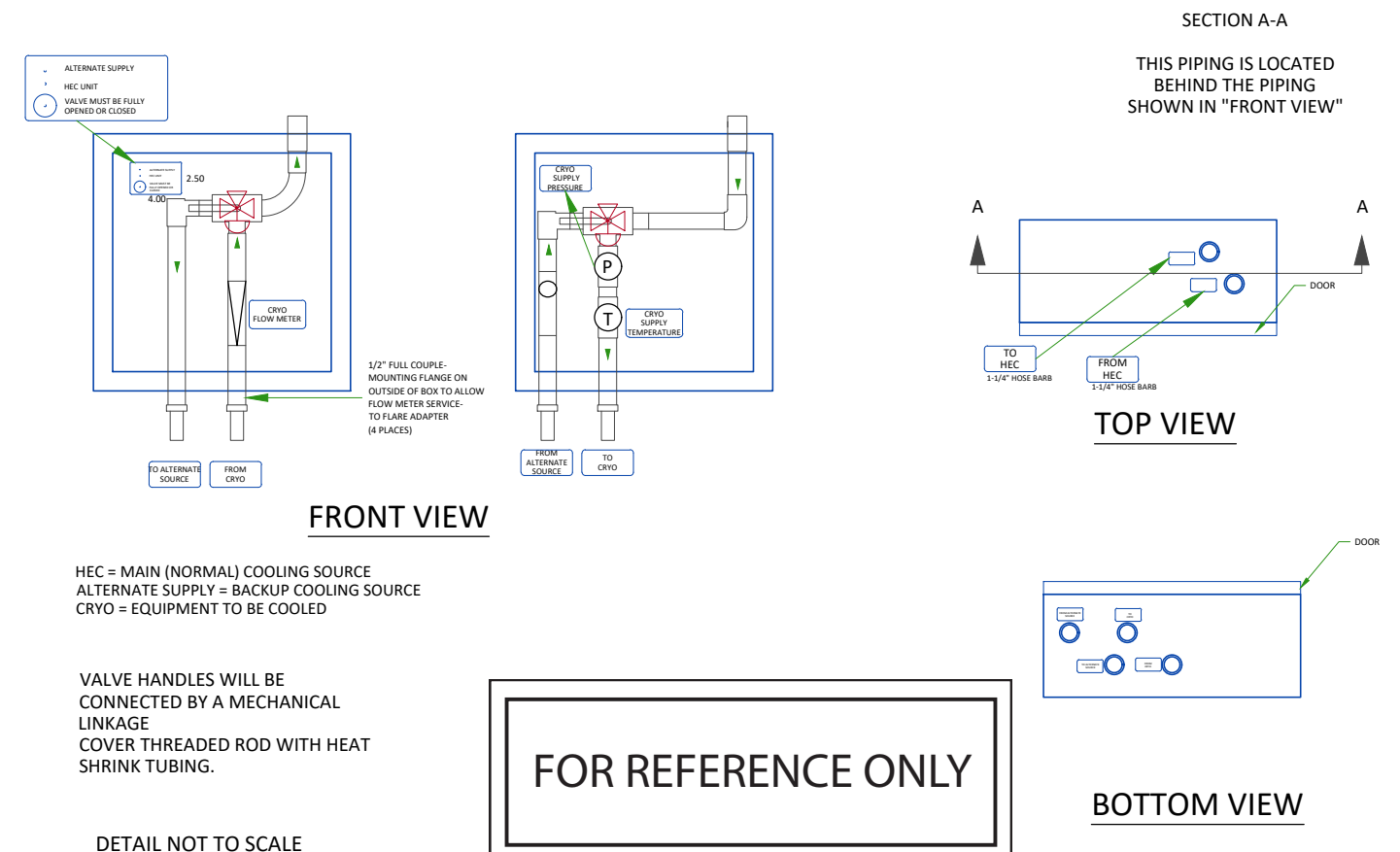
## CITY WATER BACKUP SPECIFICATIONS FOR COMPRESSOR

### INLET WATER FLOW/TEMPERATURE FOR CRYOCOOLER COMPRESSOR

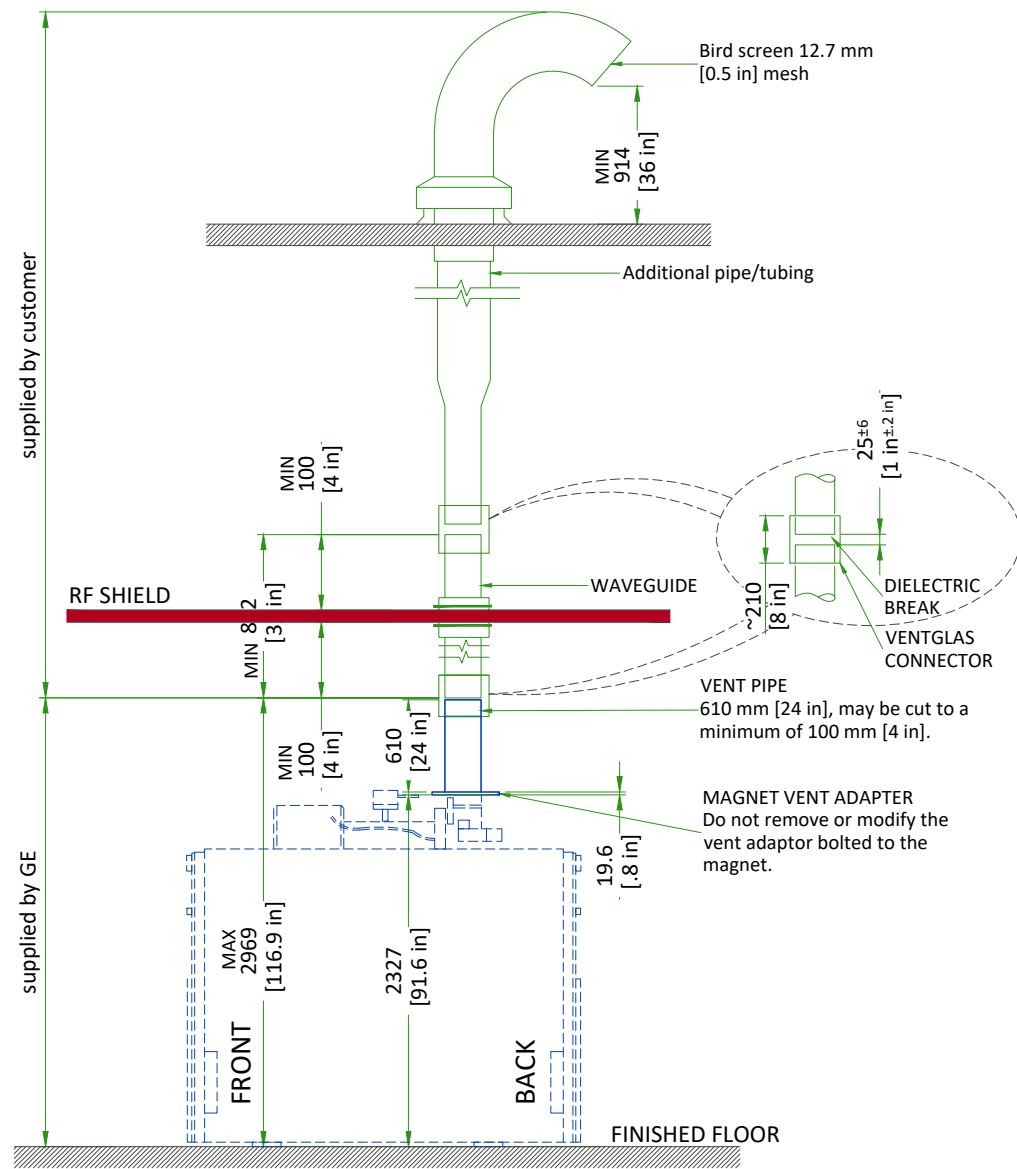


	MIN	MAX
<b>INLET TEMP</b>	39.2°F (4°C)	82.4°F (28°C)
<b>INLET FLOW</b>	1.0 gpm (4 l/min)	2.6 gpm (10 l/min)
<b>TEMP RISE</b>	89.6°F at 1.0 gpm (32°C at 4 l/min flow)	53.6°F at 2.6 gpm (12°C at 10 l/min flow)
<b>HEAT DISSIPATION (kW)</b>	7.2 kW	
<b>PRESSURE DROP</b>	8.7 psi at 2.1 gpm flow (60 kPa at 8 l/min flow)	

## MANUAL CITY WATER BACKUP SYSTEM (SAMPLE-DIMPLEX)



## TYPICAL CRYOGENIC VENT PIPE DETAIL



Waveguide is contractor supplied. Minimum 812 mm [32 in]. Must extend at least 100 mm [4 in] on magnet room side of the wall/ceiling and 25±6 mm [1±0.25 in] from the GE supplied pipe below isolation joint. Magnet room end must not be more than 2969 mm [117 in] above finished floor.

- The 203 mm [8 in] OD vent material must be one of the following materials with the wall thickness indicated:
  - SS 304: Minimum 0.89 mm [0.035 in]; Maximum 3.18 mm [0.125 in]
  - AL 6061-T6: Minimum 2.11 mm [0.083 in]; Maximum 3.18 mm [0.125 in]
  - CU DWV, M or L: Minimum 2.11 mm [0.083 in]; Maximum 3.56 mm [0.140 in]
- Either tubes or pipes may be used and must be seamless or have welded seams

### NOTE

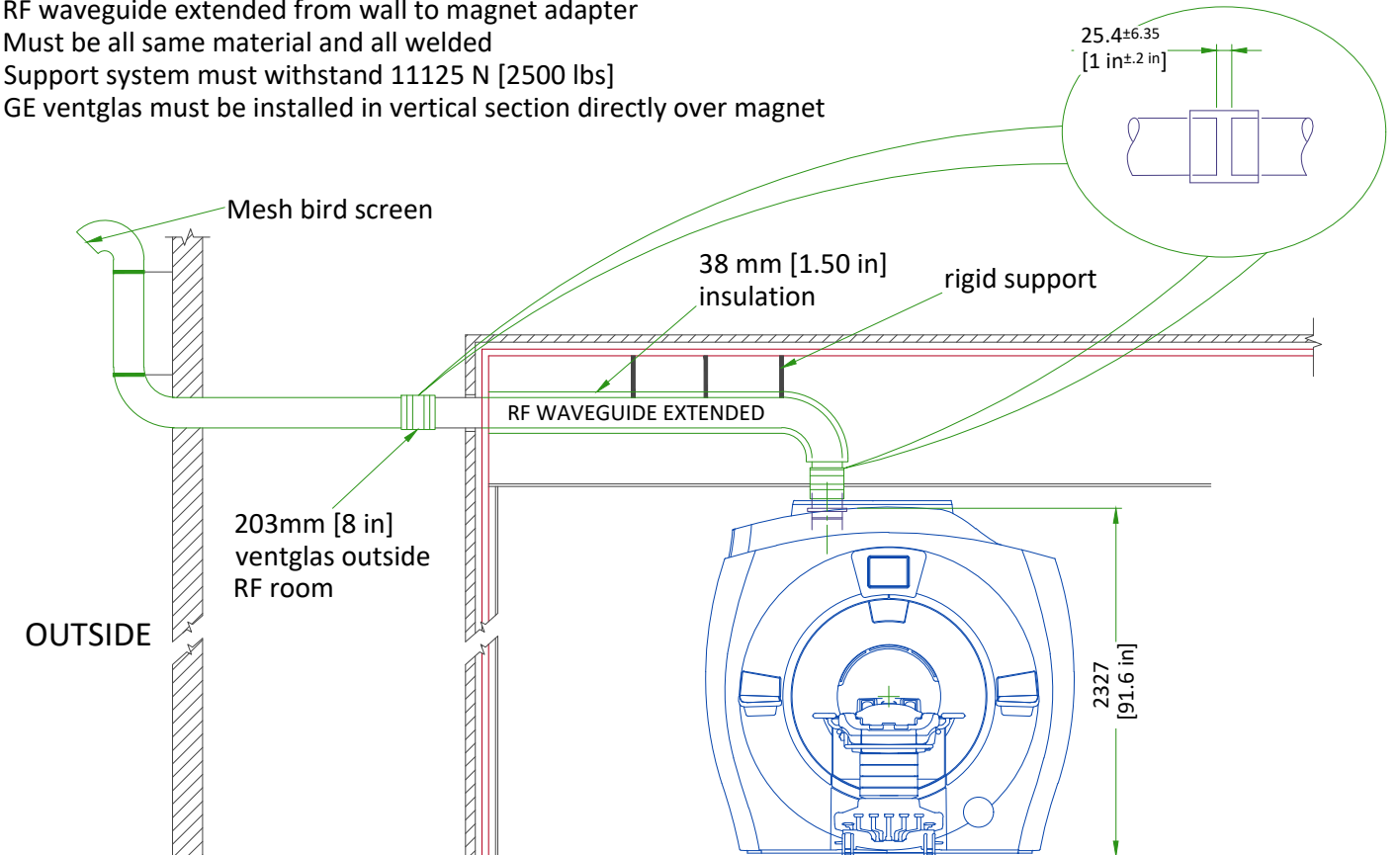
All welds on the pipe must be ground down to a smooth 203 mm [8 in] diameter so that it can be clamped to the Ventglas with enough force.

- Corrugated pipe or spiral duct must not be used
- If required, bellows pipe less than 300 mm [12 in] in length may be used as a thermal expansion joint
- The vent pipe must withstand the maximum pressure listed in the Pre-Installation Manual
- Waveguide vent material must match the outside diameter of the magnet flanged vent adapter

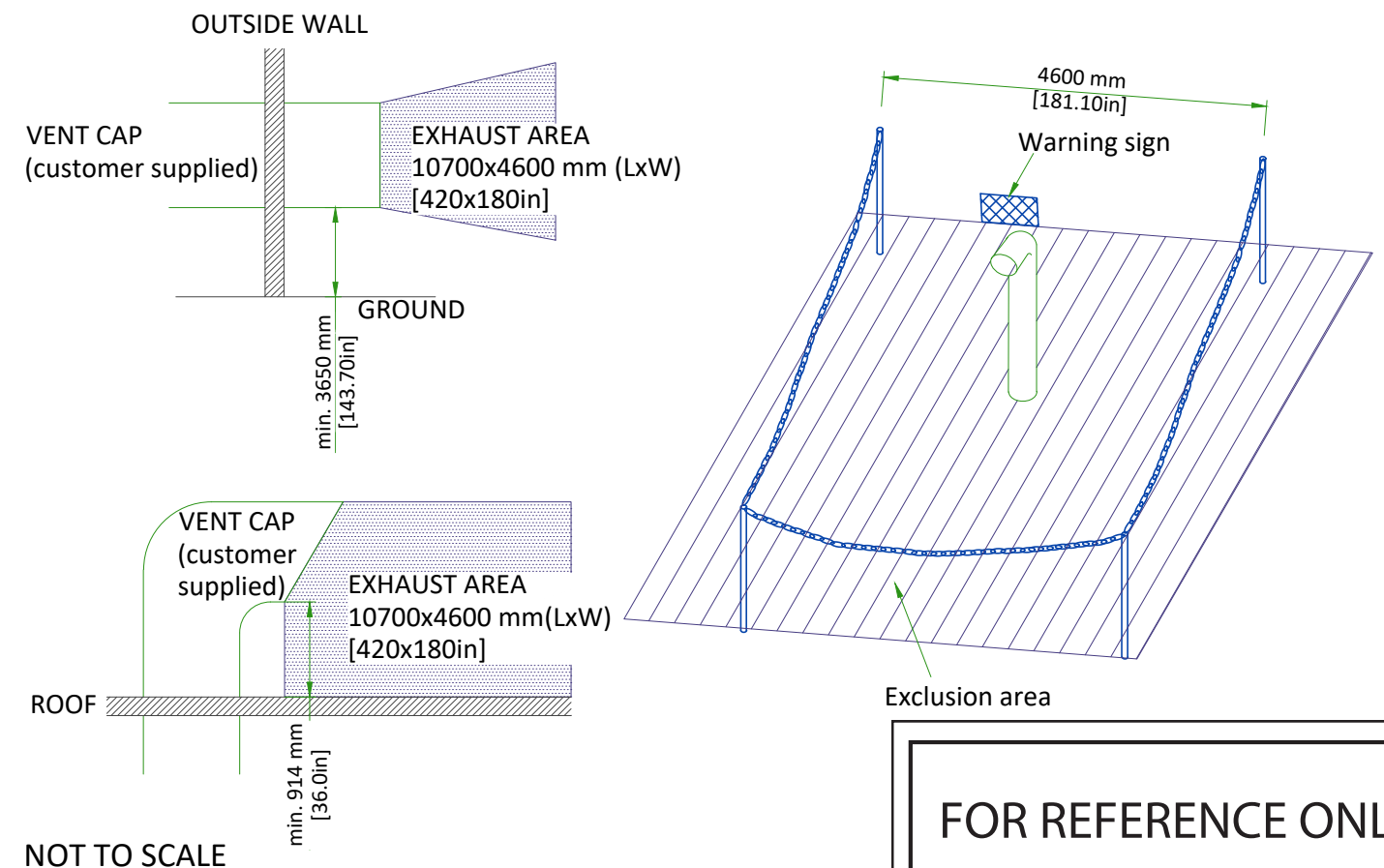
## TYPICAL CRYOGEN SIDE WALL EXIT WITH LONG SWEEP ELBOW

### KEY COMPONENTS :

- RF waveguide extended from wall to magnet adapter
- Must be all same material and all welded
- Support system must withstand 11125 N [2500 lbs]
- GE ventglas must be installed in vertical section directly over magnet



## CRYOGENIC VENTING ( EXTERIOR )



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## MAGNET CRYOGENIC VENT SYSTEM PRESSURE DROP MATRIX

Outer dia. of pipe (D)	Distance of vent system component from magnet		Pressure drop for straight pipe		Std sweep 45° elbow		Long sweep 45° elbow		Std sweep 90° elbow		Long sweep 90° elbow		90° miter bend	
	ft	m	psi/ft	kPa/m	psi	kPa	psi	kPa	psi	kPa	psi	kPa	psi	kPa
8 in. (200mm)	0-10	0.00-3.05	0.14	3.22	1.12	7.70	0.74	5.13	2.09	14.43	1.40	9.62	4.19	28.86
	10-20	3.05-6.10	0.24	5.49	1.83	12.63	1.22	8.42	3.43	23.67	2.29	15.78	6.87	47.34
	20-30	6.10-9.15	0.36	8.23	2.49	17.20	1.66	11.45	4.67	32.21	3.11	21.48	9.34	64.43
	30-40	9.15-12.2	0.47	10.65	3.11	21.42	2.07	14.26	5.82	40.11	3.88	26.74	11.64	80.23
	40-50	12.20-15.25	0.57	12.80	3.67	25.32	2.45	16.86	6.88	47.42	4.58	31.61	13.75	94.84
	50-60	15.25-18.30	0.65	14.68	4.20	28.93	2.79	19.26	7.86	54.17	5.24	36.11	15.71	108.33
	60-80	18.29-24.39	0.77	17.44	5.13	35.35	3.41	23.53	9.60	66.16	6.40	44.11	19.19	132.33
10 in. (250mm)	0-20	0.00-6.10	0.06	1.280	0.62	4.29	0.41	2.86	1.17	8.04	0.78	5.36	2.33	16.07
	20-40	6.10-12.22	0.12	2.725	1.05	7.25	0.70	4.83	1.97	13.58	1.31	9.05	3.94	27.16
	40-60	12.22-18.29	0.17	3.904	1.43	9.86	0.95	6.56	2.67	18.44	1.78	12.29	5.35	36.88
	60-80	18.29-24.39	0.21	4.859	1.76	12.14	1.17	8.07	3.29	22.70	2.19	15.13	6.58	45.40
	80-100	24.39-30.49	0.25	5.626	2.05	14.14	1.36	9.40	3.83	26.43	2.56	17.62	7.67	52.86
12 in. (300mm)	0-20	0.00-6.10	0.020	0.441	0.26	1.78	0.17	1.19	0.48	3.34	0.32	2.22	0.97	6.67
	20-40	6.10-12.22	0.041	0.937	0.43	3.00	0.29	1.99	0.81	5.61	0.54	3.74	1.63	11.22
	40-60	12.22-18.29	0.060	1.353	0.59	4.08	0.39	2.72	1.11	7.64	0.74	5.09	2.22	15.27
	60-80	18.29-24.39	0.075	1.702	0.73	5.06	0.49	3.36	1.37	9.45	0.91	6.30	2.74	18.89
	80-100	24.39-30.49	0.088	1.991	0.86	5.20	0.57	3.93	1.60	11.06	1.07	7.37	3.21	22.12
14 in. (350mm)	0-20	0.00-6.10	0.008	0.180	0.123	0.85	0.082	0.57	0.231	1.59	0.154	1.06	0.462	3.18
	20-40	6.10-12.22	0.017	0.380	0.206	1.42	0.137	0.95	0.386	2.66	0.257	1.77	0.771	5.32
	40-60	12.22-18.29	0.024	0.552	0.281	1.94	0.187	1.29	0.525	3.62	0.350	2.42	1.051	7.25
	60-80	18.29-24.39	0.031	0.699	0.349	2.41	0.232	1.60	0.652	4.50	0.435	3.00	1.304	8.99
	80-100	24.39-30.49	0.036	0.824	0.411	2.83	0.272	1.88	0.766	5.28	0.511	3.52	1.533	10.57
16 in. (400mm)	0-20	0.00-6.10	0.004	0.083	0.065	0.45	0.043	0.30	0.122	0.84	0.081	0.56	0.244	1.68
	20-40	6.10-12.22	0.008	0.174	0.108	0.75	0.072	0.50	0.202	1.39	0.135	0.93	0.404	2.79
	40-60	12.22-18.29	0.011	0.253	0.148	1.02	0.098	0.68	0.275	1.90	0.184	1.27	0.551	3.80
	60-80	18.29-24.39	0.014	0.323	0.184	1.27	0.122	0.84	0.342	2.36	0.228	1.57	0.685	4.72
	80-100	24.39-30.49	0.017	0.383	0.222	1.49	0.144	0.99	0.404	2.78	0.269	1.86	0.807	5.57

**Notes**

1. Elbows with angles greater than 90 deg must not be used
2. Data in Table 2 is based on the following facts and assumptions:
  - a. Initial flow conditions at magnet interface
  - b. EM energy (13MJ) is dumped to He during quench and rises He temperature to 10 Kelvin
  - c. Gas temperature starting at 10 Kelvin and increase with length determined by thermal energy balance
  - d. 90% He is assumed to be evacuated within 30 sec. None left after quench.
  - e. Absolute roughness is assumed to be 0.25 mm.
  - f. R/D = 1.0 for standard sweep elbows, R/D = 1.5 for long sweep elbows where D = outer diameter of pipe; R = radius of bend
3. The total pressure drop of the entire cryogenic vent system must be less than 20 psi (138 kPa). The calculation starts at the magnet vent interface and ends at the termination point outside the building.

FOR REFERENCE ONLY

## LIGHTING REQUIREMENTS

- All lighting fixtures and associated components must meet all RF shielded room and RF grounding requirements (e.g., track lighting is not recommended due to possible RF noise).
- All removable lighting fixtures and associated components must be non-magnetic.
- All lighting must use direct current (the DC must have less than 5% ripple).
- 300 lux must be provided at the front of the magnet for patient access and above the magnet for servicing.
- Fluorescent lighting must not be used in the magnet room.
- Lighting must be adjusted using a discrete switch or a variable DC lighting controller.
- SCR dimmers or rheostats must not be used.
- DC LED lighting may be used if the DC power converter and RF sources are all located outside the magnet room RF shield.

NOTE: LED lighting could cause image quality issues due to RF interference. Make sure a MR-compatible LED lighting solution is chosen.

- Battery chargers (e.g., used for emergency lighting) must be located outside the magnet room.
- Short filament length bulbs are recommended.
- Linear lamps are not recommended due to the high burnout rate.

## CONNECTIVITY REQUIREMENTS

Broadband Connections are necessary during the installation process and going forward to ensure full support from the Engineering Teams for the customers system. Maximum performance and availability for the customers system is maintained and closely monitored during the lifetime of the system. Proactive and reactive maintenance is available utilising the wide range of digital tools using the connectivity solutions listed below:

- Site-to-Site VPN/GE Solution
- Site-to-Site VPN/Customer Solution
- Connection through Dedicated Service Network
- Internet Access - connectivity for InSite 2.0

The requirements for these connectivity solutions are explained in the broadband solutions catalogue (separate document).

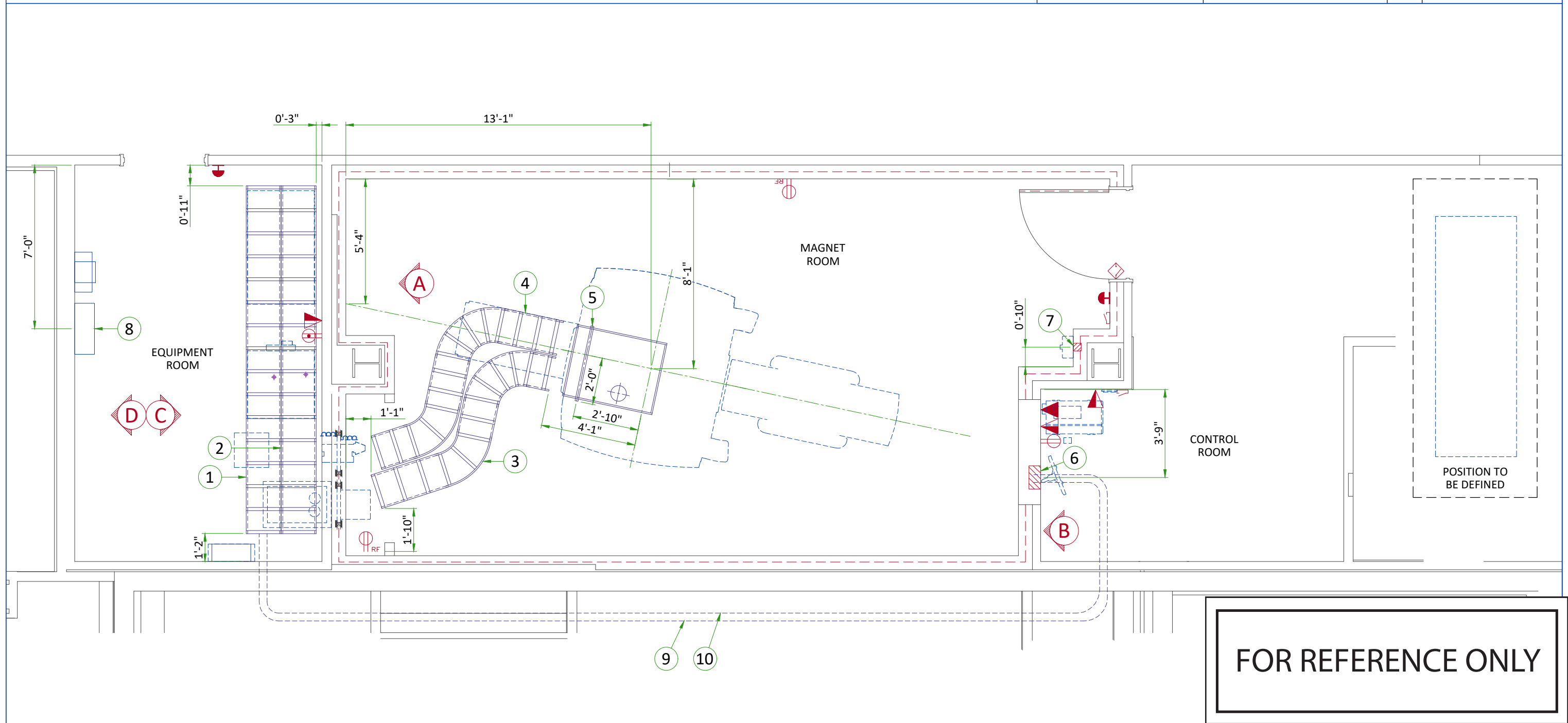
## ELECTRICAL NOTES

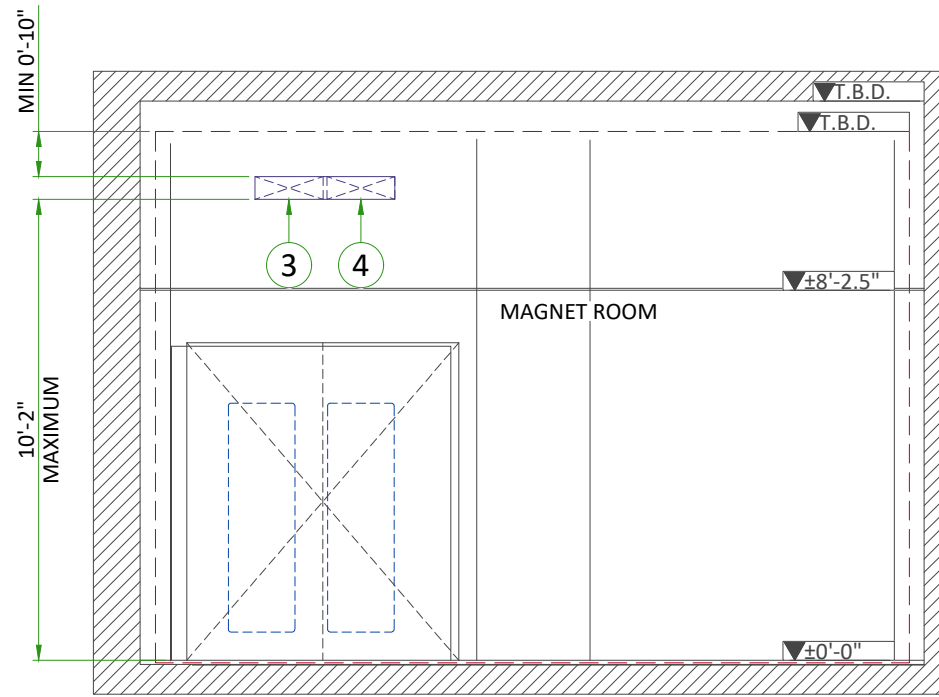
1. All wires specified shall be copper stranded, flexible, thermo-plastic, color coded, cut 10 foot long at outlet boxes, duct termination points or stubbed conduit ends. All conductors, power, signal and ground, must be run in a conduit or duct system. Electrical contractor shall ring out and tag all wires at both ends. Wire runs must be continuous copper stranded and free from splices.
  - 1.1. Aluminum or solid wires are not allowed.
2. Wire sizes given are for use of equipment. Larger sizes may be required by local codes.
3. It is recommended that all wires be color coded, as required in accordance with national and local electrical codes.
4. Conduit sizes shall be verified by the architect, electrical engineer or contractor, in accordance with local or national codes.
5. Convenience outlets are not illustrated. Their number and location are to be specified by others. Locate at least one convenience outlet close to the system control, the power distribution unit and one on each wall of the procedure room. Use hospital approved outlet or equivalent.
6. General room illumination is not illustrated. Caution should be taken to avoid excessive heat from overhead spotlights. Damage can occur to ceiling mounting components and wiring if high wattage bulbs are used. Recommend low wattage bulbs no higher than 75 watts and use dimmer controls (except mr). Do not mount lights directly above areas where ceiling mounted accessories will be parked.
7. Routing of cable ductwork, conduits, etc., must run direct as possible otherwise may result in the need for greater than standard cable lengths (refer to the interconnection diagram for maximum usable lengths point to point).
8. Conduit turns to have large, sweeping bends with minimum radius in accordance with national and local electrical codes.
9. A special grounding system is required in all procedure rooms by some national and local codes. It is recommended in areas where patients might be examined or treated under present, future, or emergency conditions. Consult the governing electrical code and confer with appropriate customer administrative personnel to determine the areas requiring this type of grounding system.
10. The maximum point to point distances illustrated on this drawing must not be exceeded.
11. Physical connection of primary power to GE equipment is to be made by customers electrical contractor with the supervision of a GE representative. The GE representative would be required to identify the physical connection location, and insure proper handling of GE equipment.
12. GEHC conducts power audits to verify quality of power being delivered to the system. The customer's electrical contractor is required to be available to support this activity.

FOR REFERENCE ONLY

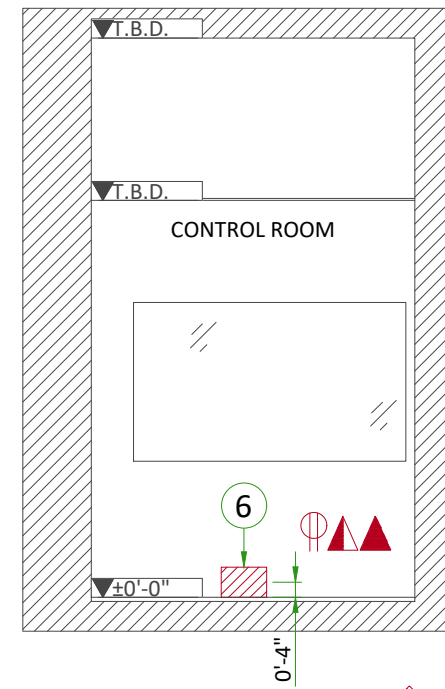
- All junction boxes, conduit, duct, duct dividers, switches, circuit breakers, cable tray, etc., are to be supplied and installed by customers electrical contractor.
- Conduit and duct runs shall have sweep radius bends
- Conduits and duct above ceiling or below finished floor must be installed as near to ceiling or floor as possible to reduce run length.
- Ceiling mounted junction boxes illustrated on this plan must be installed flush with finished ceiling.
- All ductwork must meet the following requirements:
  1. Ductwork shall be metal with dividers and have removable, accessible covers.
  2. Ductwork shall be certified/rated for electrical power purposes.
  3. Ductwork shall be electrically and mechanically bonded together in an approved manner.
  4. PVC as a substitute must be used in accordance with all local and national codes.
- All openings in access flooring are to be cut out and finished off with grommet material by the customers contractor.
- General contractor to insert pull cords for all cable run conduits between the equipment room and the operators control room.
- 10 foot pigtails at all junction points.
- Grounding is critical to equipment function and patient safety. Site must conform to wiring specifications shown on this plan.

ITEM	ELECTRICAL LAYOUT ITEM LIST	ITEM	ELECTRICAL LAYOUT ITEM LIST	Additional Conduit Runs (Contractor Supplied and Installed)				
				From	To	Qty	Size (in)	Size (mm)
1	Cable ladder 450mm x 150mm [18" x 6"]		System emergency off (SEO), (recommended height 1.2m [48"] above floor)	Main Disconnect Panel	Facility Power	1	as Req'd	
2	Cable ladder 450mm x 150mm [18" x 6"] for gradient cables		Door interlock switch (needed only if required by state/local codes)	Main Disconnect Panel	Power, Gradient, RF cabinet	1	as Req'd	
3	Non-ferrous cable ladder 450mm x 150mm [18" x 6"]		Emergency exhaust fan switch, (recommended height 1.2m [48"] above floor)		Heat Exchange Cabinet	1	as Req'd	
4	Non-ferrous cable ladder 450mm x 150mm [18" x 6"] for gradient cables		Duplex hospital grade, dedicated wall outlet 120-v, single phase power		System emergency off	1	1/2	16
5	Non-ferrous unistrut cable support		Network outlet	System emergency off	Secondary Penetration Wall	1	1/2	16
6	300mm x 200mm x 150mm [12" x 8" x 6"] Junction box		Dedicated telephone lines/network connection	Door Switch	Power, Gradient, RF cabinet	1	3/4	20
7	100mm x 100mm x 50mm [4" x 4" x 2"] Junction box @ 5'-4" A.F.F. to center		Duplex hospital grade, dedicated outlet 120-v emergency, single phase power, 15a	System emergency off	Secondary Penetration Wall	1	3/4	20
8	Main disconnect panel		Duplex hospital grade, dedicated outlet 120-v, single phase outlet routed through RF filter	Magnet Rundown Unit	Magnet	1	1	25
9	50mm [2"] Conduit above RF screen				120-V 1Ø Power from RF filter	1	as Req'd	
10	75mm [3"] Conduit above RF screen			RF filter	120-V 1Ø Power	1	as Req'd	
				Room Light	RF filter	1	as Req'd	
				RF filter	Facility emergency power	1	as Req'd	
				Chiller	Remote graphic display	1	3/4	20
					Facility power	1	as Req'd	



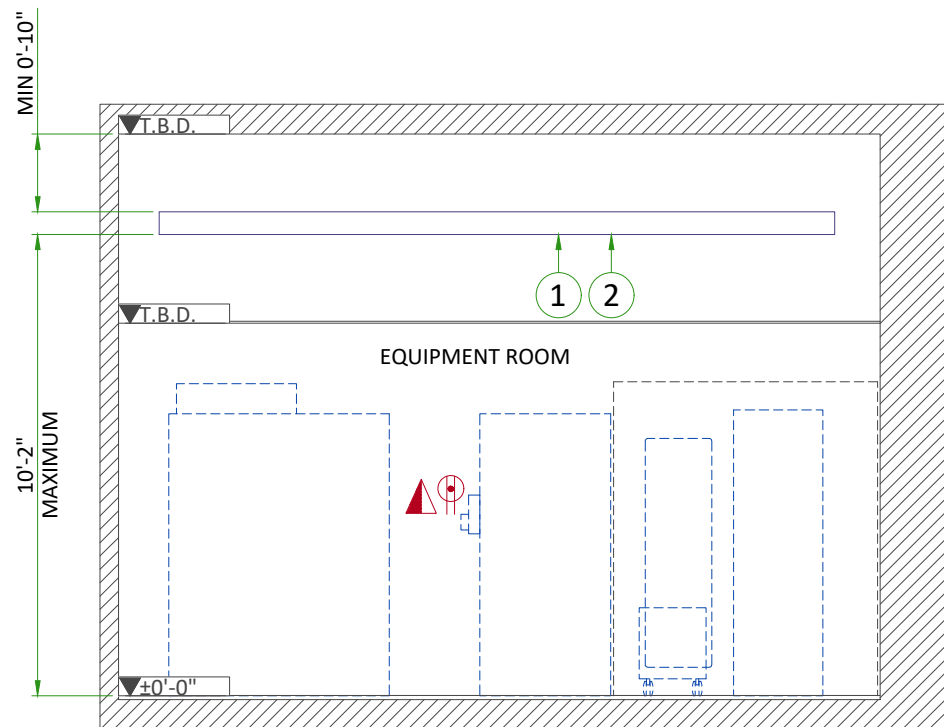


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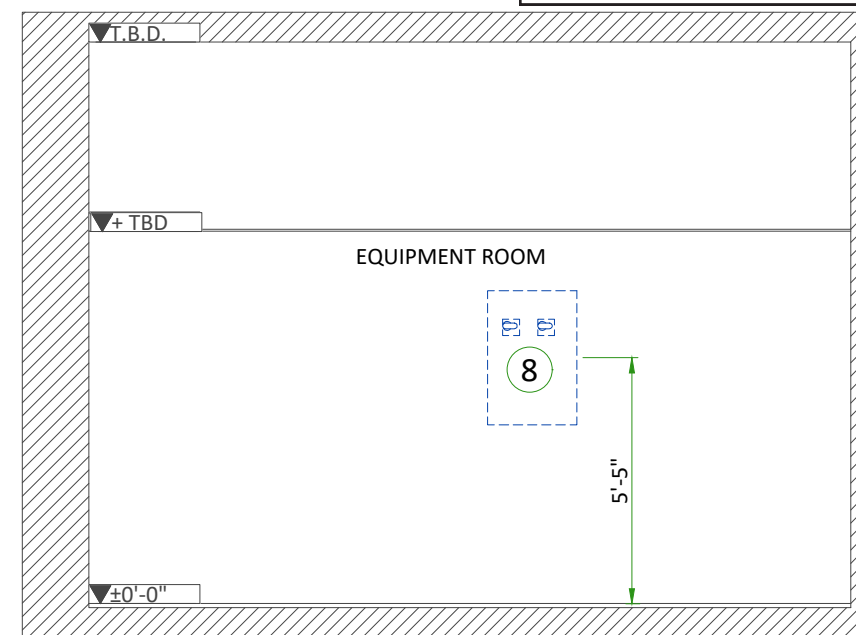


B

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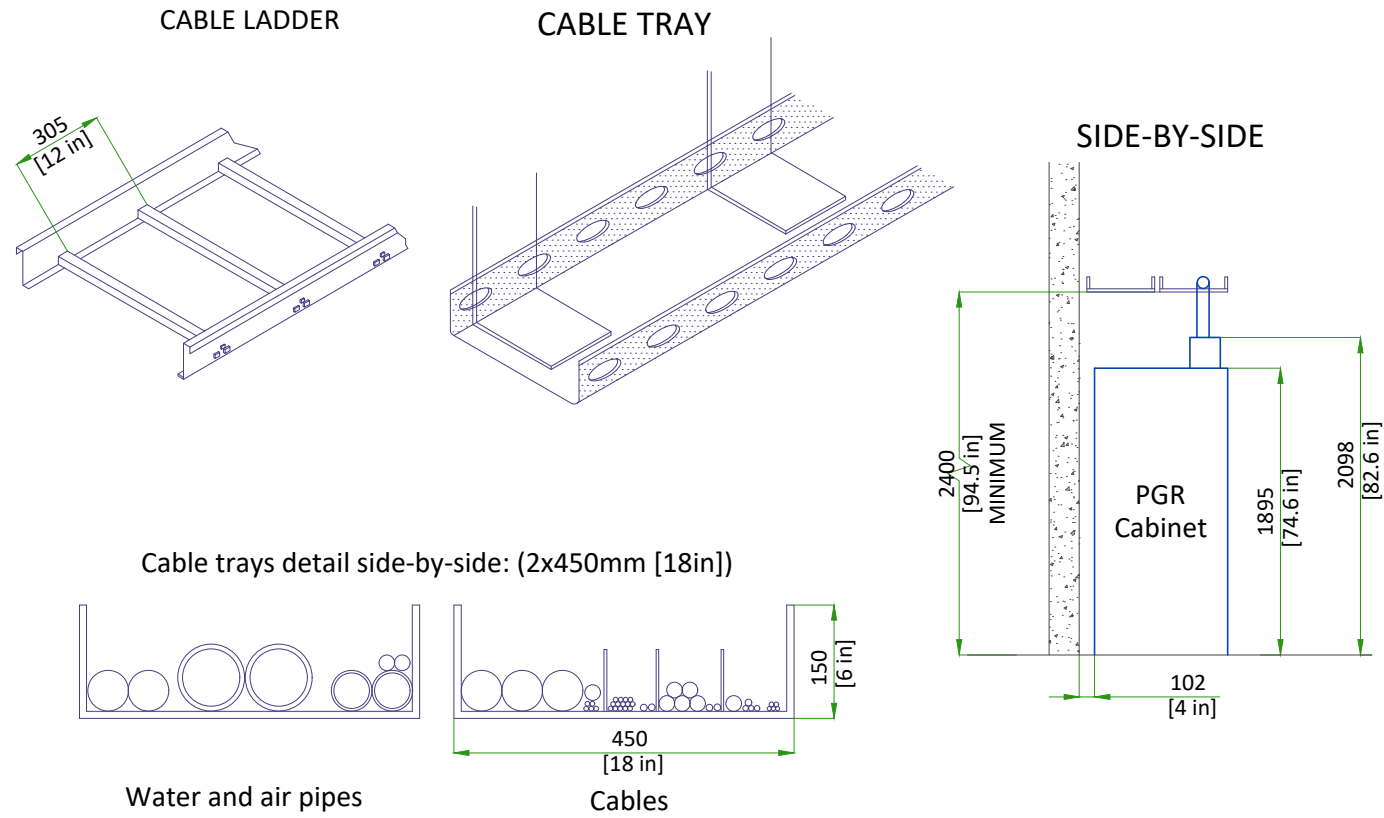


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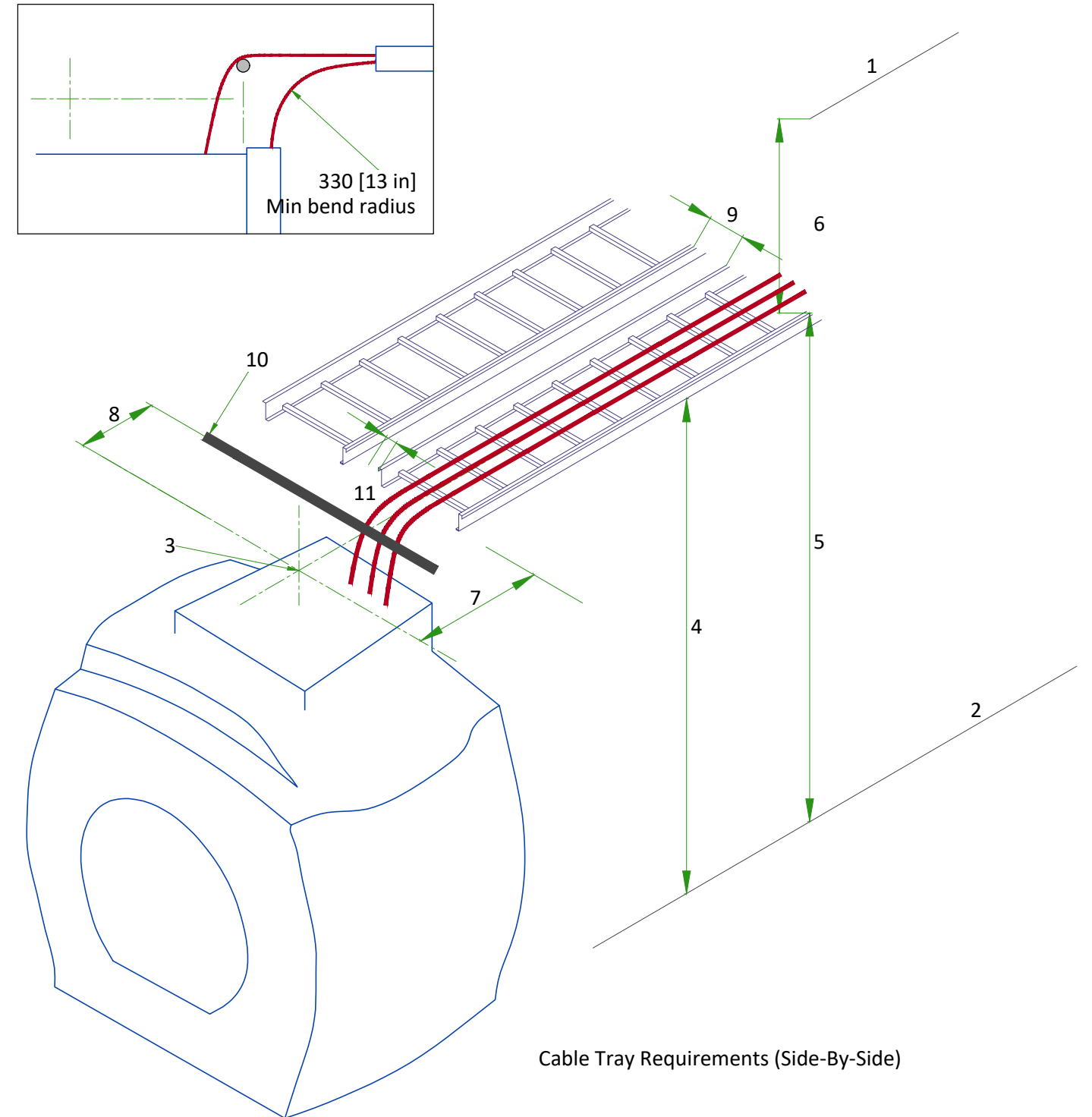


D

## CABLE WAYS IN EQUIPMENT ROOM

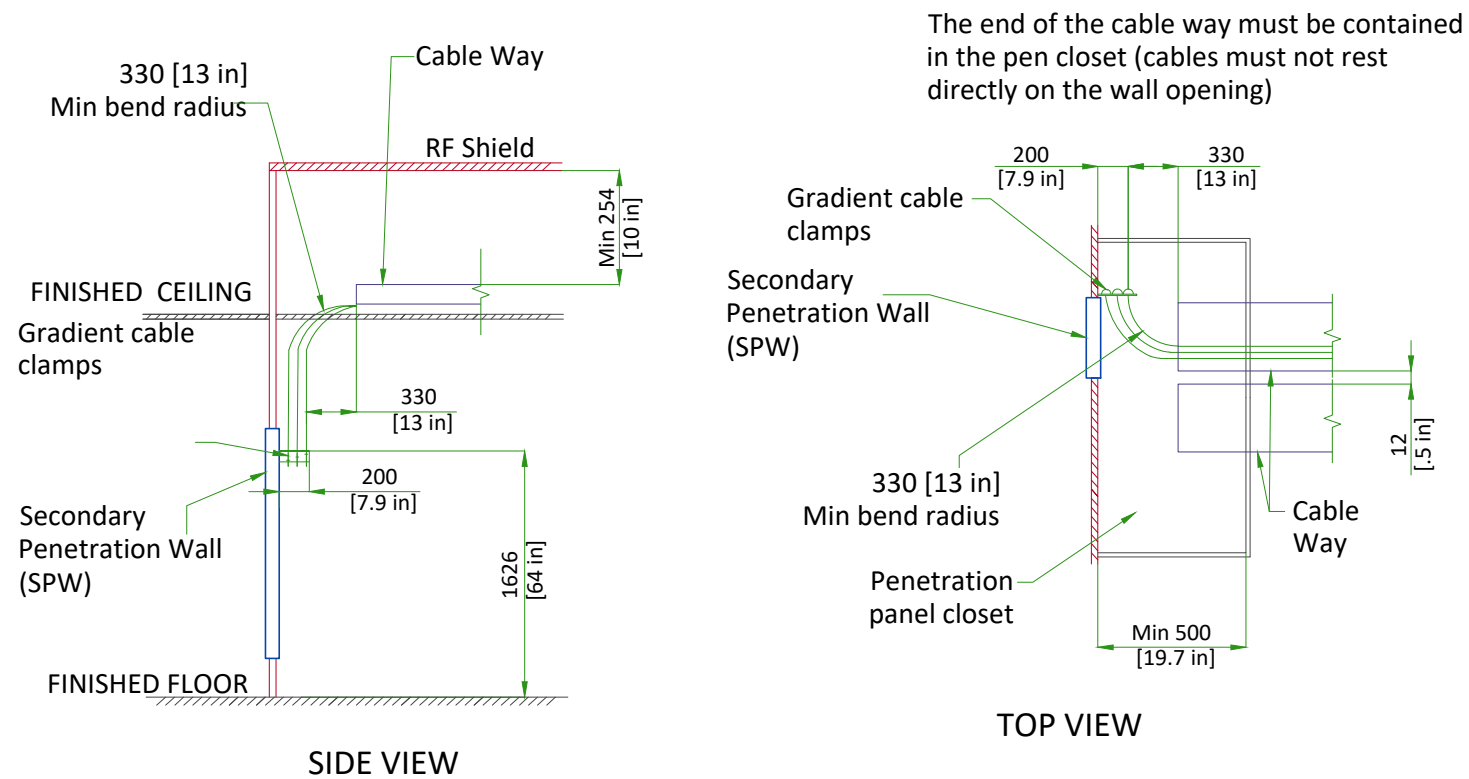


## CABLE TRAYS REQUIREMENTS IN MAGNET ROOM



## CABLE WAY TO PENETRATION PANEL

### CABLE WAY TO PENETRATION PANEL REQUIREMENTS IN THE EXAM ROOM SIDE VIEW



- 1 - Ceiling
- 2 - Finished Floor
- 3 - Magnet isocenter. Gradient cables must be centered on magnet isocenter.
- 4 - Minimum cable tray height required at back of Magnet: 2578 mm [101.5 in].  
Tray height may be lower at other points to avoid obstructions.
- 5 - Maximum height from floor to top of tray (anywhere in Magnet room): 3251 mm [128 in].
- 6 - Minimum distance from top of cable tray to ceiling or other obstruction: 254 mm [10 in].
- 7 - Tray end to isocenter: 1245 ±12 mm [49 ±0.5 in].
- 8 - Other cable termination to isocenter: 864 ±12 mm [34 ±0.5 in].
- 9 - Minimum distance between trays: 12 mm [0.5 in].
- 10 - Non-ferrous cable support

FOR REFERENCE ONLY



# POWER REQUIREMENTS

## SPECIFICATIONS OF MAIN POWER INPUT

POWER SUPPLY	380/400/415/480V ±10%, THREE-PHASE + N + G
FREQUENCIES	50/60Hz ± 3Hz
POWER FACTOR	0.9
MAXIMUM INPUT POWER (5 sec MAX)	123kVA
INSTALLED LOAD	99kVA
STAND-BY POWER	< 17kVA

- Power input must be separated from any others which may generate transients (elevators, air conditioning, radiology rooms equipped with high speed film changers...).
- Total harmonic distortion less than 2.5%.
- Phase imbalance must not exceed 2%
- Lock-out/Tag-out: The Main Disconnect Panel (MDP) shall provide an external single point lock-out/tag-out feature for the entire system and a means to externally lock-out/tag-out each output breaker independently. Each lock-out/tag-out feature shall accommodate a standard sized lock hasp..

## SPECIFICATIONS OF BACK-UP POWER SUPPLY

**MAGNET MONITOR REQUIRES A 110/220 VAC, 50/60 HZ, 2.0 A FACILITY SUPPLIED OUTLET. POWER AT THE OUTLET MUST BE CONTINUOUSLY AVAILABLE.**

### FOR CRYOCOOLER COMPRESSOR

POWER INPUT	380/400/415/480V, THREE-PHASE + G
POWER REQUIREMENT	MIN 9kVA
POWER CONSUMPTION	MAX 7.2kW / STEADY STATE 6.5kW at 50Hz MAX 8.3kW / STEADY STATE 7.5kW at 60Hz
FREQUENCY	50/60Hz ± 3Hz

## CABLES

- Power and cable installation must comply with the distribution diagram.
- Size of the Main power input cable is determined by the customer, taking its length and admissible voltage drops into consideration.
- All cables must be isolated and flexible, cable color codes must comply with standards for electrical installation.
- The cables from signaling and remote control (Y, Emergency Off Buttons, L...) will go to Main Panel with a pigtail length of 1.5m [60in], and will be connected during installation.
- Each conductor will be identified and isolated (screw connector).

## GROUND SYSTEM

- The equipotential link will be by means of an equipotential bar.
- The grounding point of MDP is directly connected to the building's ground by an isolated copper cable.
- The impedance of the earth bar should be less than or equal to 2 ohms.

FEEDER TABLE

MIN. FEEDER WIRE SIZE, AWG OR MCM (sq. M)/VAC	MINIMUM FEEDER WIRE LENGTH - ft (m)							
	100 (30.5)	150 (46)	200 (61)	250 (76)	300 (92)	350 (107)	400 (122)	450 (137)
480 VAC	3/0 (85)	3/0 (85)	3/0 (85)	3/0 (85)	3/0 (85)	3/0 (85)	3/0 (85)	3/0 (85)
GROUND REQ'D	4	4	4	4	4	4	2	2

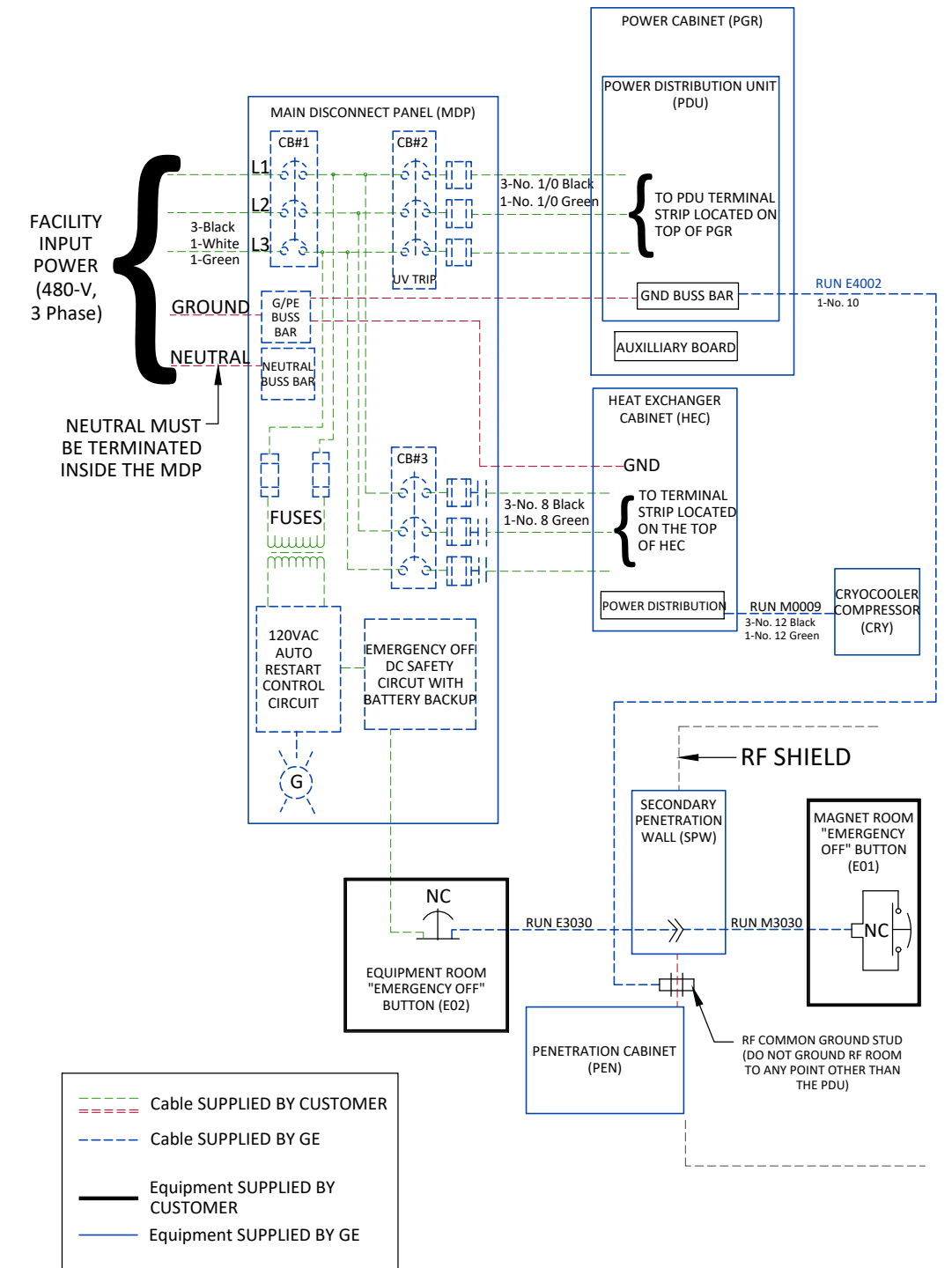
GENERAL NOTES

In all cases qualified personnel must verify that the feeder (at the point of take-off) and the run to the MR system meet all the requirements stated in the PIM

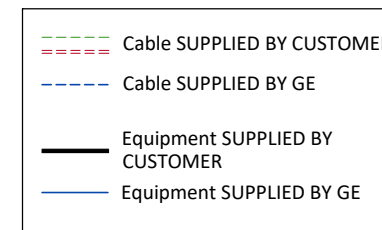
For a single unit installation, the minimum transformer size is 225KVa. Regulated transformer is not required unless voltage changes exceed +/- 10% over a period of 1 hour or longer

Grounding conductor will run from the equipment back to the power source/main grounding point and always travel in the same conduit with the feeders

# POWER DISTRIBUTION



CB	MDP
1	200 AMPS
2	150 AMPS
3	50 AMPS

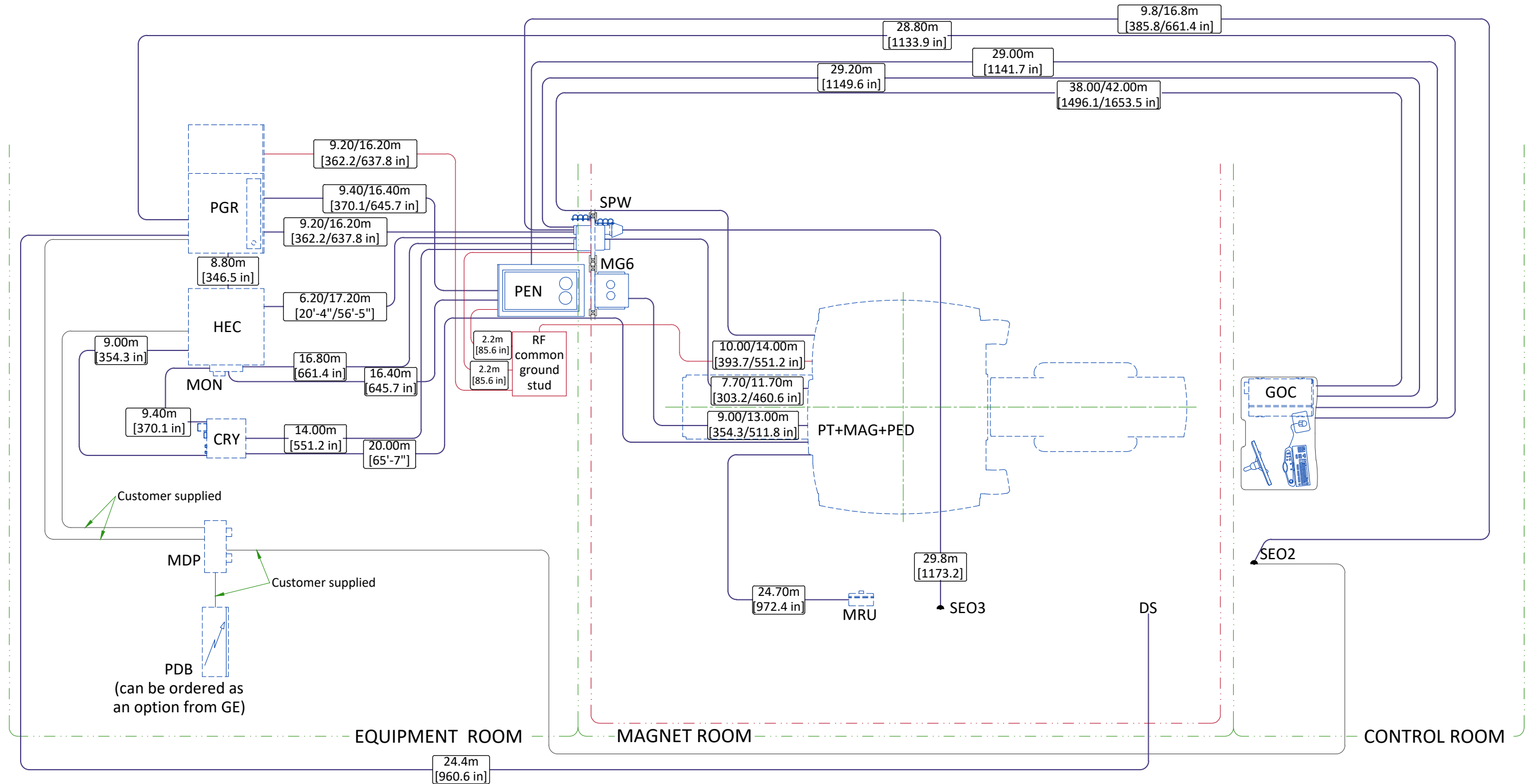


NOTE:

- THE HEAT EXCHANGER CABINET (HEC) PROVIDES POWER TO THE CRYOCOOLER COMPRESSOR (CRY) WHICH MUST OPERATE 24 HOURS PER DAY, 7 DAYS PER WEEK TO MAXIMIZE PROPER UNINTERRUPTED MAGNET OPERATION.
- RUNS E3030, M0009, M3030 AND E4002 ARE GE SUPPLIED CABLES. ALL OTHER WIRING IS CUSTOMER SUPPLIED.
- TWO REMOTE FLUSH WALL MOUNTED EMERGENCY OFF BUTTONS ARE SUPPLIED WITH THE MDP.
- MDP PROVIDES CIRCUIT BREAKERS FOR PDU (LOCATED IN THE POWER CABINET (PGR)) AND THE HEAT EXCHANGER CABINET (HEC).
- ALL MDP OUTPUT CIRCUITS DROP OUT ON LOSS OF POWER. THE HEC CIRCUIT WILL AUTOMATICALLY RESTART UPON RESTORATION OF POWER. EMERGENCY OFF LOCKS OUT ALL CONTRACTORS.
- GE MDP SHORT CIRCUIT CURRENT RATING IS 25,000 AMPERES AT 480 VAC.
- GE MDP IS UL AND cUL LABELED.
- ALL CIRCUITS REQUIRE GROUND WIRES.
- THE WIRE SIZE FOR THE EMERGENCY-OFF CIRCUIT IS 12-22 AWG CUSTOMER SUPPLIED

**FOR REFERENCE ONLY**

# INTERCONNECTIONS



CABLES ROUTING		
Configuration	Equipment Room	Magnet Room
A	Short	Short
B	Long	Short
C	Short	Long

CABLES ROUTING FOR OPTIONS				
OPTION	FROM	TO	CABLE LENGTH	
MNS	PGR	MNS	9.75 m	383.9 in
	PEN	MNS	15.80 m	622 in
	PEN	PGR	16.60 m	653.5 in
	PEN	SPW	14.00 m	551.2 in
BW	PEN	Brainwave cabinet	18.28 m	720 in
MRE	MRE	Magnet Isocenter	Nominal: 7.31m Maximum: 10.06m	Nominal: 288 in Maximum: 396 in
	MRE	PEN cabinet	15.24m	600 in
	MRE	Ethernet Hub in PGR	15.24m	600 in
	MRE	Customer Supplied Outlet	60Hz: 6.10m 50Hz: 7.62m	60Hz: 240 in 50Hz: 300 in

FOR REFERENCE ONLY





# SPECIFICATIONS

## FerrAlert™ Halo II – Ferromagnetic Detector System

Complies with ES60601-1-8 International Standard for Medical Device Alarms

Complies with IEC 60101-1:2005 Medical Device Specification Requirements

### Dimensions – Sensor Array Portal:

Height 83" (211 cm),

Depth 2.25" (5.7 cm)

### Adjustable Width:

#### 9950-A-02250 Series

42" (107 cm) to 52" (132 cm) Inside;

#### 9950-A-02260 Series

31" (79 cm) to 41" (104 cm) Inside;

#### 9950-A-02270 Series

25" (64 cm) to 35" (89 cm) Inside;

### Weight:

#### Sensor Array Portal; All Models

15.5 Lbs (7 Kg)

### Mounting:

Tension and shear specs of fasteners and brackets to Sensor Array Portal are a multiple of Fasteners through brackets and into wall.

Fastened to wall with at least 8 fasteners.

See attached chart for tension strength and shear strength of fasteners.

### Medical Rated Power Supply: (*OUTSIDE Magnet Room Installation*):

Input Power: 100 TO 240 volts AC, 57 to 63 Hz, 42 VA

Size: 5.75 inches L x 3.0 inches W x 1.75 inches H

Output Cable: 12 feet

Input Power Cord Ships w/ 3' (0.91m), 6' (1.83m), 15' (4.5m)

**Cover for Above:** 8 inches L x 12 inches W x 2.25 Inches Deep

**Weight- Supply+Cover** 3.1 Lbs ( 1.4 Kg)

### Mounting:

Fastened to wall with at least 4 fasteners.

See attached chart for tension strength and shear strength of fasteners.

### Medical Rated Power Supply: (*INSIDE Magnet Room Installation CERTIFIED*):

Input Power: 100 TO 240 volts AC, 57 to 63 Hz, 65 VA

*(User Selectable Input)*

Size: 8.0 inches L x 3.5 inches Deep x 5.0 inches H

Output Cable: 15 feet

Input Power Cord Ships w/ 3' (0.91m), 6' (1.83m), 15' (4.5m)

**Cover for Above:** 17.5 inches L x 5.7 inches W x 3.125 Inches Deep

**Weight- Supply+Cover** 6.1 Lbs ( 2.8 Kg)

### Mounting:

Fastened to wall with at least 4 fasteners.

See attached chart for tension strength and shear strength of fasteners.

# Wall-Dog™

Universal Light Duty Anchor



The Wall-Dog is an all steel, one-piece screw anchor, which features high-profile threads for easy fastening into wallboard and other masonry base materials. The deep cutting, corkscrew-like threads provide for smooth entry and a powerful hold. When removed, the Wall-Dog leaves a much smaller hole than toggles or other systems. For aesthetic appearances, the Wall-Dog is available in two color finishes: white and chrome; and in two head styles: pan and oval. For fastening into wallboard or wood, no pre-drilling is required – the anchor is inserted through the fixture and screwed in with an ordinary Phillips screwdriver. Fastening into concrete, hollow or grout-filled concrete masonry, brick and plaster requires a pre-drilled hole using a 3/16"ANSI bit. Wall-Dog anchors are ideal for light to medium duty anchoring. Typical applications include lightweight fixtures, drapery supports, as well as electrical, telephone and cable accessories.

## Ultimate Load Capacities for Wall-Dog Anchor/Fastener in Wallboard and Plywood

Anchor	1/2" Wallboard		5/8" Wallboard		3/4" Plywood	
Diameter <i>d</i>	Tension	Shear	Tension	Shear	Tension	Shear
inch (mm)	lbs. (kN)	lbs. (kN)	lbs. (kN)	lbs. (kN)	lbs. (kN)	lbs. (kN)
1/4 (6.4)	85 (0.4)	245 (1.1)	135 (0.6)	360 (1.6)	255 (1.1)	600 (2.7)

- 1 The values listed above are ultimate load capacities which should be reduced by a minimum safety factor of 4.0 or greater to determine the allowable working load.
- 2 **Above values are for one (1) Wall-Dog. The FerrAlert™ ferromagnetic detector weighs 15 pounds and is mounted with a minimum of eight(8) Wall-Dogs.**

Rev #	Revision Note	Checked by + Date	Apprv'd by + Date
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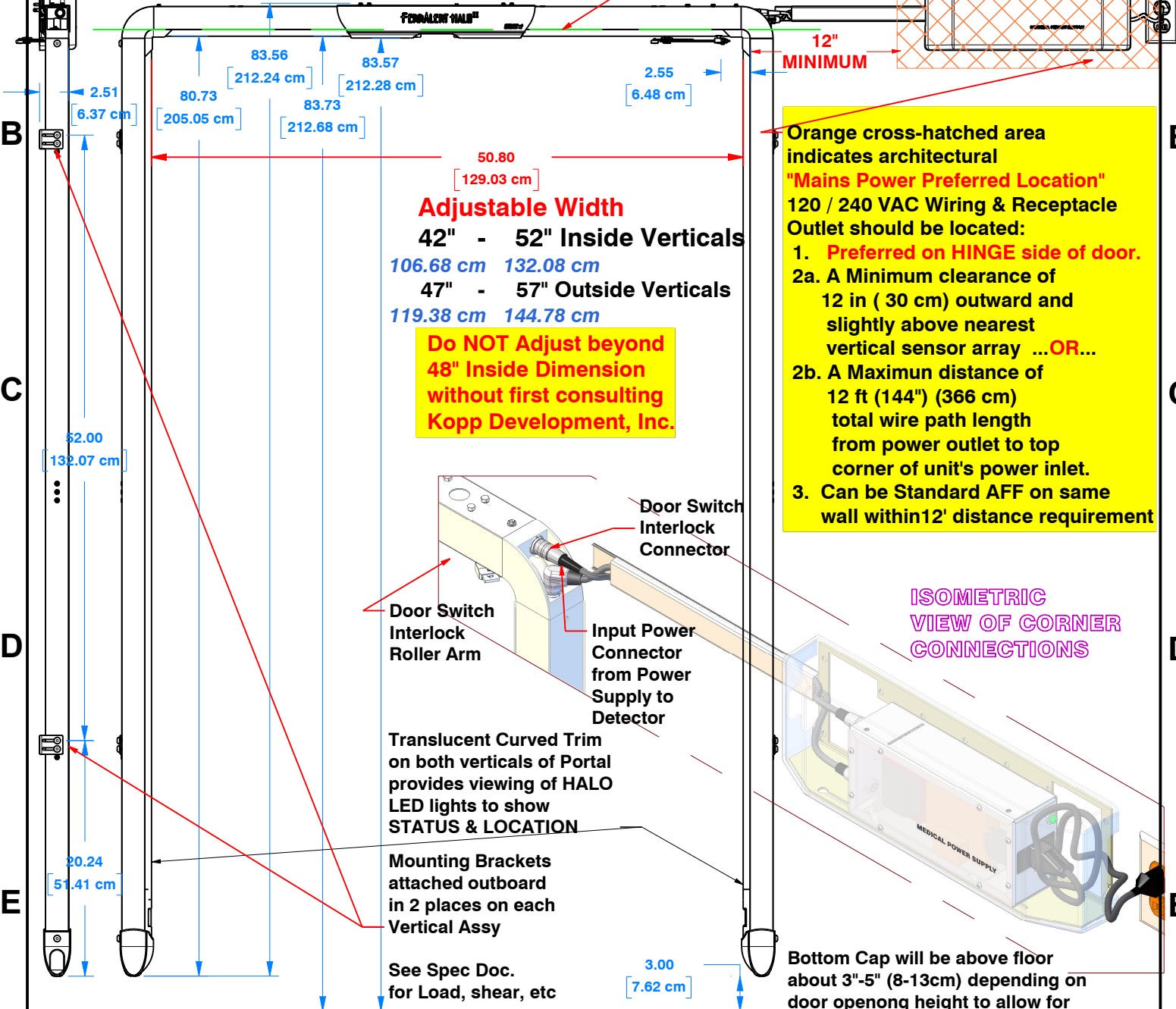
TOP VIEW

BOTTOM VIEW

SIDE VIEW

FRONT VIEW

Align this mark to top edge of door to insure viewing from INSIDE & OUTSIDE Room



# MRI FERROMAGNETIC DETECTOR INSIDE MAGNET ROOM INSTALLATION

Designed by--Date	Checked by--Date	Appr by--Date	Filename	Scale
			Part Description	
785 NE Dixie Hwy Jensen Beach FL 34957 Tele: 772-225-6932 Fax: 772-225-6291 <a href="http://www.koppdevelopment.com">www.koppdevelopment.com</a>			<b>FERRALERT™ HALO<sup>II</sup></b> <b>9950-A-02251 Series Mounting Dimensions</b>	
Size	Sheet	Part Number	<b>0040-A-02258-1a</b>	
A	of			

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