

TCMC OBSERVATION ROOM

Tri-City Medical Center

4002 Vista Way
Oceanside, California 92056

SPECIFICATIONS

SA PROJECT NO. 01643.00

12/02/16

S F E I R
A R C H I T E C T S , I N C .

1350 Columbia Street, Suite 603
San Diego, California 92101

P: 619 299 3917
F: 619 299 5084

www.sfeirarch.com

PROJECT DIRECTORY

TCMC OBSERVATION ROOM
TRI-CITY MEDICAL CENTER
OCEANSIDE, CALIFORNIA 92056

Tri-City Healthcare District
4002 Vista Way
Oceanside, California 92056
Tel: 760.940.7709
Fax: 760.940.3435

Owner

S F E I R Architects
1350 Columbia Street, Suite 603
San Diego, California 92101
Tel: 619.299.3917
Fax: 619.299.5084
Contacts:
Alexander Rodak – arodak@sfeirarch.com
Joseph Sfeir – jmsfeir@sfeirarch.com

Architect

SUN Structural Engineering, Inc.
2091 Las Palmas Drive, Suite D
Carlsbad, California 92011
Tel: 760.438.1188
Fax: 760.438.1180
Contact:
Chang Hua Sun – sunengineering@sbcglobal.net

Structural Engineer

P2S Engineering, Inc.
9665 Chesapeake Drive, Suite 230
San Diego, California 92123
Tel: 619.618-2347
Fax: 619.330.0668
Contact:
Peter Luster - paul.luster@p2seng.com

Mechanical, Plumbing,
and Electrical Engineer

Specifications Consultants, Inc.
PO Box 3010
Colorado Springs, Colorado 80934
Tel: 719.577.9414
Fax: 719.623.0172
Contact:
Paul DeArment - pdearment@specscons.com

Specifications Consultant

END OF PROJECT DIRECTORY



REVIEWED IN ACCORDANCE WITH
THE REQUIREMENTS OF T24, CCR

APPROVED

Laura Baldrati, Senior Architect

July 06, 2017

Office of Statewide Health
Planning & Development
FACILITIES DEVELOPMENT DIVISION

SEALS PAGES

TCMC OBSERVATION ROOM
TRI-CITY MEDICAL CENTER
OCEANSIDE, CALIFORNIA 92056

ARCHITECT-OF-RECORD'S SEAL

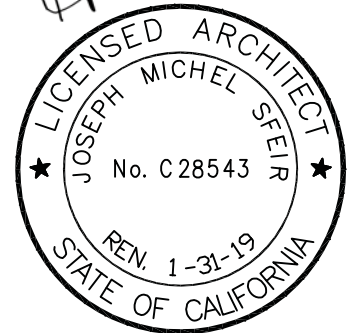
Sfeir Architects
1350 Columbia Street, Suite 603
San Diego, California 92101

by

Joseph Sfeir

Printed Name

Signature



STRUCTURAL ENGINEER-OF-RECORD'S SEAL

SUN Structural Engineering, Inc.
2091 Las Palmas Drive, Suite D
Carlsbad, California 92011

by

Changhua Sun

Printed Name

Signature



MECHANICAL ENGINEER-OF-RECORD'S SEAL

P2S Engineering, Inc.
9665 Chesapeake Drive, Suite 230
San Diego, California 92123

by

Paul Luster

Printed Name

Signature



Responsible for Divisions 21 through 23

TCMC Observation Room
Tri-City Medical Center
SA Project No. 01643.00

SEALS PAGES
00 01 07 - 1

ELECTRICAL ENGINEER-OF-RECORD'S SEAL

P2S Engineering, Inc.
9665 Chesapeake Drive, Suite 230
San Diego, CA 92123

Responsible for Divisions 26 through 28

by

Kurt Kaiser

Kurt Kaiser Printed Name
Signature



END OF SEALS PAGES

**TCMC OBSERVATION ROOM
TRI-CITY MEDICAL CENTER
4002 VISTA WAY
OCEANSIDE, CALIFORNIA 92056**

**SPECIFICATIONS
12/02/16**

TABLE OF CONTENTS

SPECIFICATIONS GROUP

GENERAL REQUIREMENTS SUBGROUP:

DIVISION 01 GENERAL REQUIREMENTS

| | | |
|----------|---|-----|
| 01 10 00 | Summary..... | 1-4 |
| 01 22 00 | Unit Prices..... | 1 |
| 01 25 00 | Substitution Procedures..... | 1-2 |
| 01 26 00 | Contract Modification Procedures..... | 1-2 |
| 01 29 00 | Payment Procedures..... | 1-4 |
| 01 31 13 | Project Coordination..... | 1-2 |
| 01 31 19 | Project Meetings..... | 1-2 |
| 01 33 00 | Submittal Procedures..... | 1-6 |
| 01 35 16 | Alteration Project Procedures..... | 1-4 |
| 01 41 00 | Regulatory Requirements..... | 1-2 |
| 01 42 00 | References..... | 1-4 |
| 01 45 20 | Quality Control Services..... | 1-3 |
| 01 50 00 | Temporary Facilities and Controls..... | 1-4 |
| 01 60 00 | Product Requirements..... | 1-3 |
| 01 61 65 | Low-Emitting Material Requirements..... | 1-4 |
| 01 71 16 | Acceptance of Conditions..... | 1-2 |
| 01 73 19 | Installation..... | 1-2 |
| 01 73 29 | Cutting and Patching..... | 1-2 |
| 01 77 00 | Closeout Procedures..... | 1-4 |
| 01 78 36 | Warranties..... | 1-2 |

FACILITY CONSTRUCTION SUBGROUP:

DIVISION 02 EXISTING CONDITIONS

| | | |
|-------------|--|-----|
| 02 41 19.16 | Selective Interior Demolition..... | 1-5 |
| 02 42 00 | Removal and Salvage of Construction Materials..... | 1-2 |

DIVISION 03 CONCRETE

| | | |
|----------|---|-----|
| 03 20 00 | Concrete Reinforcing..... | 1-3 |
| 03 30 53 | Miscellaneous Cast-in-Place Concrete..... | 1-4 |

DIVISION 04 MASONRY - Not Used

DIVISION 05 METALS

| | | |
|----------|--------------------------------------|-----|
| 05 05 19 | Post-Installed Concrete Anchors..... | 1-5 |
| 05 40 00 | Cold-Formed Metal Framing..... | 1-2 |
| 05 50 00 | Metal Fabrications..... | 1-3 |

| | |
|--|--|
| <i>DIVISION 06 WOOD, PLASTICS AND COMPOSITES</i> | |
| 06 10 53 | Miscellaneous Rough Carpentry.....1-3 |
| 06 41 00 | Architectural Wood Casework.....1-6 |
| <i>DIVISION 07 THERMAL AND MOISTURE PROTECTION</i> | |
| 07 26 16 | Below-Grade Vapor Retarders.....1-4 |
| 07 84 00 | Firestopping.....1-5 |
| 07 92 00 | Joint Sealants.....1-6 |
| <i>DIVISION 08 OPENINGS</i> | |
| 08 11 13 | Hollow Metal Doors and Frames.....1-4 |
| 08 31 00 | Access Doors and Panels.....1-6 |
| 08 71 00 | Door Hardware.....1-21 |
| 08 84 00 | Plastic Glazing.....1-4 |
| <i>DIVISION 09 FINISHES</i> | |
| 09 05 61 | Common Work Results for Flooring Preparation.....1-9 |
| 09 21 16 | Gypsum Board Assemblies.....1-12 |
| 09 51 13 | Acoustical Panel Ceilings.....1-4 |
| 09 65 16 | Resilient Sheet Flooring.....1-6 |
| 09 81 16 | Acoustic Blanket Insulation.....1-2 |
| 09 91 23 | Interior Painting.....1-7 |
| <i>DIVISION 10 SPECIALTIES</i> | |
| 10 26 23 | Protective Wall Covering.....1-3 |
| 10 28 13 | Toilet Accessories.....1-2 |
| <i>DIVISION 11 EQUIPMENT</i> | |
| 11 73 13 | Psychiatric Seclusion Room Padding.....1-2 |
| <i>DIVISION 12 FURNISHINGS</i> | |
| 12 24 13 | Roller Window Shades.....1-7 |
| 12 36 61 | Simulated Stone Countertops.....1-5 |
| <i>DIVISION 13 SPECIAL CONSTRUCTION - Not Used</i> | |
| <i>DIVISION 14 CONVEYING EQUIPMENT - Not Used</i> | |
| <i>DIVISIONS 15 TO 19 - Reserved</i> | |

FACILITY SERVICES SUBGROUP:

DIVISION 20 - Reserved

DIVISION 21 FIRE SUPPRESSION - Not Used

| | |
|-----------------------------|---|
| <i>DIVISION 22 PLUMBING</i> | |
| 22 05 00 | Common Work Results For Plumbing.....1-11 |
| 22 05 23 | General-Duty Valves For Plumbing Piping.....1-12 |
| 22 05 29 | Hangers And Supports For Plumbing Piping and Equipment.....1-11 |
| 22 05 53 | Identification For Plumbing Piping And Equipment.....1-5 |
| 22 07 00 | Plumbing Insulation.....1-28 |
| 22 11 16 | Domestic Water Piping.....1-16 |
| 22 11 19 | Domestic Water Piping Specialties.....1-13 |

| | | |
|----------|--|------|
| 22 13 16 | Sanitary Waste And Vent Piping..... | 1-11 |
| 22 13 19 | Sanitary Waste Piping Specialties..... | 1-13 |
| 22 43 00 | Healthcare Plumbing Fixtures..... | 1-12 |

DIVISION 23 HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

| | | |
|-----------|---|------|
| 23 00 10 | Mechanical General Requirements..... | 1-10 |
| 23 00 50 | Basic Mechanical Materials And Methods..... | 1-11 |
| 23 05 00 | Common Work Results For HVAC..... | 1-10 |
| 23 05 19 | Meters And Gages For HVAC Piping..... | 1-6 |
| 23 05 23 | General-Duty Valves For HVAC Piping..... | 1-6 |
| 23 05 29 | Hangers And Supports For HVAC Piping And Equipment..... | 1-9 |
| 23 05 48 | Vibration And Seismic Controls For HVAC Piping And Equipment..... | 1-7 |
| 23 05 53 | Identification For HVAC Piping And Equipment..... | 1-6 |
| 23 05 93 | Testing, Adjusting, And Balancing For HVAC..... | 1-10 |
| 23 07 13 | Duct Insulation..... | 1-12 |
| 23 07 19 | HVAC Piping Insulation..... | 1-21 |
| 23 09 00 | Instrumentation And Control For HVAC..... | 1-17 |
| 23 09 70 | Direct Digital Control (DDC) System Commissioning..... | 1-15 |
| 23 09 95 | Mechanical System Commissioning..... | 1-3 |
| 23 09 95a | Exhibit A- Sample Pre-Functional Checklist..... | 1-3 |
| 23 09 95b | Exhibit B - Sample Functional Test Plan..... | 1-2 |
| 23 21 13 | Hydronic Piping..... | 1-10 |
| 23 21 16 | Hydronic Piping Specialties..... | 1-4 |
| 23 31 13 | Metal Ducts..... | 1-12 |
| 23 33 00 | Air Duct Accessories..... | 1-8 |
| 23 36 00 | Hydronic Heating Coils..... | 1-5 |
| 23 37 13 | Diffusers, Registers, And Grilles..... | 1-3 |

DIVISION 24 - Reserved

DIVISION 25 INTEGRATED AUTOMATION - Not Used

DIVISION 26 ELECTRICAL

| | | |
|----------|---|------|
| 26 00 10 | Electrical General Provisions..... | 1-13 |
| 26 05 00 | Common Work Results For Electrical..... | 1-4 |
| 26 05 19 | Low-Voltage Electrical Power Conductors And Cables..... | 1-6 |
| 26 05 26 | Grounding And Bonding For Electrical Systems..... | 1-8 |
| 26 05 29 | Hangers And Supports For Electrical Systems..... | 1-5 |
| 26 05 33 | Raceway And Boxes For Electrical Systems..... | 1-26 |
| 26 05 53 | Identification For Electrical Systems..... | 1-8 |
| 26 27 26 | Wiring Devices..... | 1-10 |
| 26 57 00 | Medical Facilities..... | 1-3 |

DIVISION 27 COMMUNICATIONS - Not Used

DIVISION 28 ELECTRONIC SAFETY AND SECURITY - Not Used

DIVISION 29 - Reserved

SITE AND INFRASTRUCTURE SUBGROUP:

DIVISION 30 - Reserved

DIVISION 31 EARTHWORK
31 23 33 Trenching and Backfilling.....1-5

DIVISION 32 EXTERIOR IMPROVEMENTS - Not Used

DIVISION 33 UTILITIES - Not Used

DIVISION 34 TRANSPORTATION - Not Used

DIVISION 35 WATERWAY AND MARINE CONSTRUCTION - Not Used

DIVISIONS 36 TO 39 - Reserved

PROCESS EQUIPMENT SUBGROUP:

DIVISIONS 40 TO 49 - Not Used

END OF TABLE OF CONTENTS

DIVISION 01 – GENERAL REQUIREMENTS

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.

1.02 PROJECT IDENTIFICATION AND PRINCIPAL ENTITIES

- A. Project Identification and Location:

TCMC Observation Room
Tri-City Medical Center
4002 Vista Way
Oceanside, California 92056

- B. Owner: Wherever the word "Owner" is used in this Project Manual, it shall mean:

Tri-City Healthcare District
4002 Vista Way
Oceanside, California 92056

- C. Architect: Wherever the word "Architect" is used in this Project Manual, it shall mean:

S F E I R Architects
1350 Columbia Street, Suite 603
San Diego, California 92101

- 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: The Work consists of renovation in the existing Behavioral Health Unit (BHU) on the first floor of the TCMC facility.
 - 1. Renovation of existing Patient Room 168 in the BHU to an observation room with an anteroom and an accessible toilet room.
 - 2. Modify existing wall and cabinetry between the new Observation Room and the adjacent nurse station for a window in the wall.
- 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 hazardous material 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 Occupancy: Owner will 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 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.
 - b. Section 01 50 00 Temporary Facilities and Controls.
- 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.

1.07 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 through 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

SECTION 01 22 00

UNIT PRICES

PART 1 GENERAL

1.01 GENERAL

- A. Quantities indicated on the Drawings or extra quantities specified shall be included in the Contractor's Base Bid. For ADDING or DEDUCTING from Base Bid quantities, the unit prices described in this section will be applied. The Contractor will be notified in writing of the quantities applicable to each unit price and Contract Price will be adjusted accordingly by change order.
- B. All unit prices shall include all labor, materials, equipment, services, delivery to the Project, overhead, profit, insurance and all other incidental expenses to complete the work specified. All work covered by unit prices shall be performed in accordance with requirements of the applicable sections of the specifications.

1.02 UNIT PRICES

- A. Unit Price for Vapor Emission Control Treatment of Floor Slabs: See Section 09 05 61 Common Work Results for Flooring Preparation.
 - 1. Unit of Measure: Square foot of floor slab area treated.
 - 2. Bidding Requirements: Bidders shall indicate unit price for specified vapor emission control treatment on their bid forms.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

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.
- 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 specified 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. Division 01 Section "Submittal Requirements" for requirements for the Contractor's Construction Schedule.
 - 2. Division 01 Section "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 "Products Substitutions" 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.

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 "Submittals".

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. Relate 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 Contractor's 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 include but not limited to the following:
 - 1. List of subcontractors and their agreements with the Contractor.
 - 2. List of principle suppliers and fabricators.
 - 3. Schedule of Values.
 - 4. Contractors Construction Schedule (preliminary if not final).
 - 5. Schedule of principle products.
 - 6. Submittal Schedule (preliminary if not final).
 - 7. List of Contractor's staff assignments.
 - 8. List of Contractor's principle 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

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 Section "Project Meetings."
 - 1. Requirements for the Contractor's Construction Schedule are included in Section "Submittals."

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 COORDINATION

- 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 01700.
 - 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 SUMMARY

- A. This Section specifies administrative and procedural requirements for project meetings including but not limited to:
 - 1. Pre-Construction Conference.
 - 2. Pre-Installation Conferences.
 - 3. Progress Meetings.
- B. Construction schedules are specified in another Division-01 Section.

1.02 PRE-CONSTRUCTION CONFERENCE

- A. Schedule a pre-construction conference and organizational meeting at the Project site or other convenient location no later than 5 days after the notice to proceed and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.
- B. Attendees: The Owner, Architect and their consultants, the Prime Contractors and their superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.
- C. Agenda: Discuss items of significance that could affect progress including but not limited to such topics as:
 - 1. Tentative construction schedule.
 - 2. Critical Work sequencing.
 - 3. Designation of responsible personnel.
 - 4. Procedures for processing filed decisions and Change Orders.
 - 5. Procedures for processing Applications for Payment.
 - 6. Distribution of Contract Documents.
 - 7. Submittal of Shop Drawings, Product Data and Samples.
 - 8. Preparation of record documents.
 - 9. Use of the premises.
 - 10. Office, work and storage areas.
 - 11. Equipment deliveries and priorities.
 - 12. Safety procedure
 - 13. First aid.
 - 14. Security
 - 15. Housekeeping.
 - 16. Working Hours.

1.03 PRE-INSTALLATION CONFERENCES

- A. Conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction and as specified herein. 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 Schedule meeting dates.

- B. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference.
- C. Do not proceed if the conference cannot be successfully concluded. Indicate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.04 PROGRESS MEETINGS

- A. Conduct progress meetings at Project site bi-weekly. Coordinate dates of meeting with preparation of the payment request.
- B. Attendees: In addition to representative of the Owner and Architect, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.
- C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current of the Project.
 - 1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 2. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule to the Owner and Architect.

PART 2 PRODUCTS – Not used

PART 3 EXECUTION – Not used

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including:
 - 1. Contractor's construction schedule.
 - 2. Submittal schedule.
 - 3. Construction progress photographs.
 - 4. Shop Drawings.
 - 5. Product Data.
 - 6. Samples.
- B. Administrative Submittals: T=Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
 - 1. Permits.
 - 2. Applications for payment.
 - 3. Performance and payment bonds.
 - 4. Insurance certificates.
 - 5. List of Subcontractors.
- C. The schedule of Values submittal is included in Section "Applications for Payment."
- D. Inspection and test reports are included in Section "Quality Control Services."

1.02 SUBMITTAL PROCEDURES

- A. 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 delays.
 - 1. Coordinate each submittal with fabricate, purchasing, testing, delivery, other submittals and related activities that require sequential activities.
 - 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 constructed for coordination.
 - a. The Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Processing: Allow sufficient review time so that installation will not be delayed as result of the time required to process submittals, including time for resubmittals.
 - 1. Allow two weeks for initial review. Allow Additional time if processing must be delayed to permit coordination with subsequent submittals. The Architect will promptly advise the contractor when a submittal being processed must be delayed for coordination.
 - 2. If an intermediate submittal is necessary, process the same as initial submittal.
 - 3. Allow two weeks for reprocessing each submittal.
 - 4. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the work to permit processing.

- C. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
1. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings and product Data to record the Contractor's review and approval markings and the action taken for accuracy, completeness and compliance with the Contract Documents. Submittals without evidence of the Contractor's review and approval will be returned for resubmission.
 2. Include the following information on the label for processing and recording action taken.
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name manufacturer.
 - h. Number and title of appropriate Specifications Section.
 - i. Drawings number and detail references, as appropriate.
- D. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using a transmittal form with copy of transmittal to Owner. Submittal received from sources other than the Contractor will be returned without action.
1. On the transmittal Record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirement, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

1.03 CONTRACTORS' CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: The General Contractor shall prepare a fully developed, horizontal bar-chart type contractors' construction schedule. Submit within 10 days of the date of the notice to proceed.
1. Provide a separate time bar for each significant construction activity including the related contracts activities. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the work as indicate in the "Schedule of Values."
 2. Within each time bar indicated estimate completion percentage in 10 percent increments. As Work progress, place a contrasting mark in each bar to indicate Actual Completion.
 3. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
 4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
 5. Coordinate the Contractors' construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other schedule.
 6. Indicate completion in advance of the date established for schedule Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.
- B. Distribution: Following response to the initial submittal, print and distribute copies to the Architect, Owner, related Prime Contractor, subcontractors, and other parties require to comply with schedule dates. Post copies in the project meeting room and temporary field office.
1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

- C. Schedule Updating: Revise and reissue the schedule after each meeting or activity, where revisions have been recognized or made.

1.04 SUBMITTAL SCHEDULE

- A. After development and acceptance of the Contractors' construction schedule, each Prime Contractor shall prepare a complete schedule of submittals. Submit the schedule within 10 days from the Pre-Construction Conference.
- B. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.
- C. Prepare the schedule in chronological order; include submittals required during the first 30 days of Construction. Provide the following information:
 - 1. Schedule date for the first submittal.
 - 2. Related Section number.
 - 3. Submittal category.
 - 4. Name of subcontractor.
 - 5. Description of the part of the work covered.
 - 6. Scheduled date for resubmittal.
 - 7. Scheduled date for the Architect's final release or approval.
- D. Distribution: Following response to initial submittal, print and distribute copies to the Architect's, Owner, subcontractors, and other parties required to comply with submittal date indicated. Post copies in the Project meeting room and file in office.
 - 1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.
- E. Schedule Updating: Revise and reissue the schedule after each meeting or activities, where revisions have been recognized or made.

1.05 SHOP DRAWINGS

- A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.
- B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
 - 1. Dimensions.
 - 2. Identification of products and materials included.
 - 3. Completion with specified standards.
 - 4. Notation of coordination requirements.
 - 5. Notation of dimensions established field measurement.
- C. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2"x11" but not larger than 30" x 42"
- D. Initial Submittal: To Architect submit one correctable translucent reproducible print and one blue- or black-line print for the Architect's review; the reproducible print will be returned.

- E. Final Submittal: To Architect a minimum of blue- or black-line prints; submit 8 prints where required for maintenance manuals. 5 prints will be retained; the remainder will be returned.
 - 1. One of the prints returned shall be marked-up and maintained as a "Record Document".
 - 2. Do not Shop drawings without an appropriate final stamp indicating action taken in connection with construction.

1.06 PRODUCT DATA

- A. Collect product Data into a single submittal for each element of construction or system. Product Data included printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as ' Shop Drawings".
- B. Mark each copy to show applicable choices and options. Where printed Product Data included information on several products, some of which are not required. Mark copies to indicate the applicable information. Include the following information:
 - 1. Manufacturer's printed recommendations.
 - 2. Compliance with recognized trade association standards.
 - 3. Compliance with recognized testing agency standards.
 - 4. Application of testing agency labels and seals.
 - 5. Notation of dimensions verified by field measurement.
 - 6. Notation of coordination requirements.
- C. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
- D. Preliminary Submittal: To Architect submit a preliminary single-copy of product Data where selection of options is required.
- E. Submittals: To Architect submit a minimum of 7 copies of each required submittal; submit 8 copies where required for maintenance manuals. The Architect will retain 5 copies. And will return the other marked with action taken and corrections or modifications required.
- F. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and other required for performance of construction activities. Show distribution on transmittal form with copy being sent to Architect and Owner.

1.07 SAMPLES

- A. Submit to Architect full-size, fully fabricate Sample cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricate components, cuts or containers of materials; color ranges sets, and swatches showing color, texture and pattern.
- B. Mount, display, or package Samples in the manner specified to facilitate review of qualities indicated. Prepare Samples to match the Architect's Sample. Include the following:
 - 1. Generic description of the Sample.
 - 2. Sample source.
 - 3. Product name or name of manufacturer.
 - 4. Compliance with recognized standards.
 - 5. Availability and delivery time.

- C. Submit to Architect Samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristic between the final submittal and the actual component as delivered and installed.
 - 1. Where variation in color, pattern, texture or other characteristic are inherent in the material or product represented, submit multiple units (not less than 3), that show approximate limits of the variations.
 - 2. Refer to other Specification sections for requirements for Samples that illustrate workmanship. Fabrication techniques, details of assembly, connections, operation and similar construction characteristic.
 - 3. Refer to other Sections for Samples to be returned to the Contractor for incorporation in the Work. Such Samples must be undamaged at time of use. On the transmittal of Sample submittals.
- D. Preliminary submittals: Where Samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.
 - 1. Preliminary submittals will be reviewed and returned with the Architect's mark indicating selection and other action.
- E. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 3 sets; one will be returned marked with the action taken.
 - 1. Maintain sets of Samples, as returned, at the Project site, for Quality comparisons throughout the course of construction.
 - 2. Unless no completion with Contract Document provisions is observed, the submittal may serve as the final submittal.
 - 3. Sample sets may be used to obtain final acceptance of the construction associate with each set.
- F. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, supplies, installers, and others as required for performance of the work. Show distribution on transmittal form sent to Architect And Owner.
- G. Filed Samples specified in individual Sections are special types of Samples. Field Samples are full-size examples erected on site to illustrate finish coats, or finishing materials and to establish the standard by which the Work will be judge.
 - 1. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.08 ARCHITECT'S ACTION

- A. Except for submittals for record, information or similar purposes, here action and return is required or requested, the Architect will review each submittal, mark to indicate action taken, and promptly.
 - 1. Compliance with specified characteristics is the Contractor's responsibility.
- B. Action Stamp: The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken.
 - 1. Final Unrestricted Release: Where submittals are marked "No Exception Taken," that part of the work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 - 2. Final-but-Restricted Release: When submittals are marked "Make Corrections Noted," that part of the work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend upon that compliance.

3. Returned for Resubmittal: When submittal is marked "Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
4. Do not permit submittals marked "Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.
5. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

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 19.16 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 Interior Demolition: Section 02 41 19.16.

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 74 00, 01 50 00 and 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 and Regulatory Requirements Data on Sheets A1-00 through A1-02 of the 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. Allow access to the Project site at any time to OSHPD designated Inspector of Record (IOR) for the Project.
 - 3. File OSHPD Verified Report forms every three months during construction.
 - 4. Office of Statewide Health Planning and Development (OSHPD) Building Permit will be obtained and paid for by Owner.
- 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 Code of Regulations (CCR), Title 8, Chapter 4, Subchapter 6, Elevator Safety Orders
 - California Code of Regulations (CCR), Title 19, Public Safety
 - California Code of Regulations (CCR), Title 22, Social Security
 - California Code of Regulations (CCR), Title 24, Building Standards, Including, but not limited to:
 - Part 1 - 2013 California Building Standards Administrative Code (CAC)
 - Part 2 - 2013 California Building Code (CBC)
 - Part 3 - 2013 California Electrical Code (CEC)
 - Part 4 - 2013 California Mechanical Code (CMC)
 - Part 5 - 2013 California Plumbing Code (CPC)
 - Part 6 - 2013 California Energy Code
 - Part 9 - 2013 California Fire Code (CFC)
 - Part 10 - 2013 California Existing Building Code
 - Part 11 - 2013 California Green Building Standards Code
 - Part 12 - 2013 California Referenced Standards Code

1.04 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

1.05 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.

1.06 DISCREPANCIES

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

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

END OF SECTION

SECTION 01 42 00

REFERENCES

PART 1 GENERAL

1.01 DEFINITIONS

- A. General: Basic Contract definitions are included in the General Conditions.
- B. Indicated: The term “indicated” refers to graphic representations, notes, or schedule on the Drawings, other paragraphs or schedule in the Specifications, and similar requirements in the Contract Documents. Where terms such as “shown”, “noted”, “scheduled,” and “specified” are used it is to help the reader locate the reference; no limitations on location is intended.
- C. Directed: Terms such as “directed,” “requested,” “authorized,” “selected”, “approved,” “required,” and “permitted” mean “directed by the Architect,” “requested by the Architect, and similar phrases.
- D. Approve: The term “approved,” where used in conjunction with the Architect’s action on the Contractor’s submittals, applications, and requirements, is limited to the Architect’s duties and responsibilities as stated in General and Supplementary Conditions.
- E. Regulation: The term “Regulations” included 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.
- F. Furnish: The term “furnish” is used to mean “supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.”
- G. Install: The term “install” is used to describe operations at project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
- H. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use.”
- I. Installer: An “installer” is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term “experienced” when used with the term “Installer” means having a minimum of 5 previous Projects similar in size and scope to this Project, being familiar with the precautions required, and having complied with requirements of the authority having jurisdiction.
- J. Trades: Use of titles such as “carpentry” is not intended to 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 tradesperson of the corresponding generic name.
- K. Assignment of Specialists: Certain Sections of the Specifications require that specified construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and

assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.

1. This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with Local trade union jurisdictional settlements and conventions.
- L. Project Site is the space available to the Contractor for Performance of 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 upon which the Project is to be built.
- M. Testing Laboratories: A "testing laboratory" 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.
- N. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.
- O. Approved Equals-Equivalents:
 1. The words "similar and equal to", "or equal", equivalent" and such other words of similar content and meaning shall for the purposes of this contract be deemed to mean similar and equivalent to one of the named products. For the purpose of this article and for the purpose of the bidding documents, the word "products" shall be deemed to include the words "articles", "materials", "items", "equipment" and "methods". Whenever in the contract documents one or more products are specified, the words "similar and equal to" shall be inserted.
 2. Wherever any product is specified in the contract documents by a reference to the name, trade name, or catalog number of any manufacturer or supplier, the intent is not to limit competition, but to establish a standard of quality which the Architect has determined is necessary for the project. The Contractor may at their option use any product other than that specified in the contract documents provided the same is approved by the Architect in accordance with the acceptable procedures. However no substitutions will be allowed after bidding that changes product type or system type, as specified herein unless otherwise noted.
- P. Nothing in the contract documents shall be construed as representing, expressly or impliedly, that the named product is available or that there is or there is not a product similar and equal to any of the name products and the Contractor shall have and make no claim by reason of the availability of lack of availability of the named product or of a product similar and equal to any named product.

1.02 TECHNICAL SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. Technical Specification Format: These Technical Specifications are organized into Divisions and Sections on the basis of the 2014 Update to 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 through Division 49, some of which are not used or are reserved for future expansion of the MasterFormat.
- B. Technical Specification Content: This Technical Specification uses certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
 1. Abbreviated Language: Language used in Technical Specifications and other Contract Documents is the abbreviated type. Implied words and meaning will be appropriately

- interpreted. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and the full context of the Contract Documents so indicates.
2. Specification Methods: The techniques or methods of specifying to record requirements varies throughout text, and may include "prescriptive," "open generic descriptive," "compliance with standards," "performance," "proprietary," or a combination of these. The method used for specifying one unit of work has no bearing on requirements for another unit of work.
 3. Overlapping and Conflicting Requirements: Where compliance with 2 or more industry standards or sets of requirements is specified, and overlapping of those different standards or requirements establishes different or conflicting minimum or levels of quality, the most stringent requirement is intended and will be enforced.
- C. Contractor's Options: Except for overlapping or conflicting requirements, where more than one set of requirements are specified for a particular unit of work, option is intended to be Contractor's regardless of whether or not it is specifically indicated as such.
1. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended to be the minimum for the work to be performed or proved. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances). Or may exceed that minimum within reasonable limits. In complying with these requirements, indicated numeric values are either minimums or maximums as noted or as appropriate for context of the requirements. Refer instances of uncertainty to Architect/Engineer for decision before proceeding.
 2. Specialists, Assignments: In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements should not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the work; they are also not intended to interfere with local union jurisdiction settlements and similar Conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, The final responsibility for fulfillment of the entire set or requirements remains with the Contractor.
 3. Trades: Except as otherwise indicated, the use of titles such as "Carpentry" in specification text, implies neither that the work must be performed by an accredited or unionized tradesperson of corresponding generic name (such as "carpenter"), nor specified requirements apply exclusively to work by tradespersons of that corresponding generic name.

1.03 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable Construction industry standards have the same force and effects as if bound or copied directly into the Contract Documents. Such Standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.
- C. Conflicting Requirements: Where compliance with two or more standards specified, and the standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to the Architect for a decision before proceeding.
 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable

limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Architect for a decision before proceeding.

- D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of documents are needed for performance of a required construction activity, the Contractor shall obtain Copies from the publication source.
 - 2. Although copies of standards needed for enforcement of requirements may be included as part of required submittals, the Architect reserves the right to require the Contractor to submit additional copies as necessary for enforcement of requirements.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade associations, standards generating organization, authority having jurisdiction, or other entity application to the context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in, most libraries.

1.04 SUBMITTALS

- A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, Licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipt for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 PRODUCTS – Not used

PART 3 EXECUTION – Not used

END OF SECTION

SECTION 01 45 20

QUALITY CONTROL SERVICES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies administrative and procedural requirements for quality control services.
- B. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.
- D. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Those requirements, including inspections and test, cover production of standard products as well as customized fabrication and installation procedures.
- E. Inspection, test and related actions specified are not intended to limit the Contractor's control procedures that facilitate compliance with Contract Document requirements.
- F. Requirements for the Contractor to provide quality control services required by the Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.02 RESPONSIBILITIES

- A. Testing Agency: The District will employ and pay an independent agency, subject to approval by the Architect, to perform specified quality control services.
- B. Retesting: The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements.
- C. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to.
 - 1. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and test.
 - 2. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
 - 3. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
 - 4. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 - 5. Security and protection of Samples and test equipment at the Project site.
- D. Duties of the Testing Agency: The independent testing agency engaged to perform inspections, sampling and testing of materials and construction Sections shall cooperate with the Architect

and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.

1. The agency shall notify the Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
 3. The agency shall not perform any duties of the Contractor.
- E. Coordination: The Contractor and each agency engaged to perform inspections; tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition to Contractor, each agency shall coordinated activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
- F. The Contractor is responsible for scheduling time for inspections, tests, taking samples and similar activities

1.03 SUBMITTALS

- A. The independent testing agency shall submit a certified written report of each inspection, test or similar service directly to the Architect, in duplicate, with a copy to the Contractor.
- B. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
- C. Report Data: Written reports of each inspection, test or similar services shall include, but not be limited to:
1. Date of issue.
 2. Project title and number.
 3. Name, address and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making the inspection or test.
 6. Designation of the Work and test method.
 7. Identification of product and specification Section.
 8. Complete inspection or test data.
 9. Test results and an interpretation of test results.
 10. Ambient conditions at the time of sample taking and testing.
 11. Comments or professional opinion as to whether inspection or tested Work complies with Contract Document Requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample-taking and similar services, repair damage construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with Contract Document requirements for 'Cutting and Patching.'

- B. Protect construction exposed by or for quality control service activities, and protect repaired construction.
- C. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

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.
- 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.
- B. Temporarily remove existing window for construction access and exhaust filtered construction duct. Close off opening securely with plywood at the end of each day's work.

3.09 TEMPORARY CONTROLS

- A. General: Comply with local codes, ordinances and regulations.
 - 1. See Section 02 41 19.16 for related requirements during demolition.
- 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 TEMPORARY PARTITIONS

- A. Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate occupied areas from fumes and noise.
- B. Where indicated, provide 1-hour rated temporary gypsum board partition from floor to underside of partition above with a 20-minute rated temporary door.
- C. Provide infection control polyethylene sheeting with a zipper where indicated.

3.11 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. This Section specifies administrative, and procedural requirements governing the Contractor's selection of products for use in the Project.
- B. The Contractor's Constructions Schedule and the Schedule of submittals are included under Sections "Submittal Procedures."
- C. Standards: Refer to Section "References" for applicability of industry standards to products specified.

1.02 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structures," "finishes," "Accessories," and similar. Such terms such are self-explanatory and have well recognized meanings in the construction industry.
 - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "Material," "equipment," "system," and terms of similar intent.
 - 2. "Named Products" are items identified by manufacture's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
 - 3. "Foreign Products", as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions; or produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens nor living within the United States and its possessions.
 - 4. "Materials", are products that substantially shaped, cut, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to inform a part of the Work.
 - 5. "Equipment", is a product with operational part, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.03 QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.
 - 1. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect for a determination of the most important product qualities before proceeding. Qualities may include attributes relating to visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources that produce products that possess these qualities, to the fullest extent possible.
- B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Projects, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

- C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:
 - 1. No available domestic product complies with the Contract Document.
- D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacture's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
- E. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.
- F. Equipment Nameplates: Provide a permanent nameplate on each item on service-connected or power-operated equipment. Locate on an easily accessible surface, which are inconspicuous occupied spaces. The nameplate shall contain the following information and other essential operating data:
 - 1. Name of product and manufacturer.
 - 2. Model and serial number.
 - 3. Capacity.
 - 4. Speed.
 - 5. Ratings.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle products in accordance with the manufacture's recommendations, using meanings and methods that will prevent damage, deterioration and loss, including theft.
- B. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
- C. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damage, or sensitive to deterioration, theft and other losses.
- D. Deliver Products to the site in the manufacture's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
- E. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.
- F. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
- G. Store heavy materials away from the project structure in a manner that will not endanger the supporting construction.
- H. Store products subjects to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 PRODUCTS

2.01 PRODUCT SELECTION

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.
 - 1. Provide products complete with an accessories, trim, finish, safety guards and other. Indicates and details needed for a complete installation and for the intended use and effect.
- B. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- C. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:
 - 1. Where products or manufactures are specified by name, accompanied by the term "or equal," or "or approved equal " comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
 - 2. 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.
 - 3. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.
 - 4. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.
 - 5. Compliance with Standards, Codes and Regulations: Where the Specification only requires compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.
 - 6. Visual Matching: Where Specifications require matching and established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.
 - 7. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with provisions of the Contract Documents concerning " substitutions " for selection of a matching product in another product category, or for noncompliance with specified requirements.
 - 8. 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 comply with other specified requirements. The Architect will select the color, patterned and texture from the product line selected.

PART 3 EXECUTION

3.01 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
 - 1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until the time of Substantial Completion.

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 interior adhesives.
 - 2. Common VOC requirements for interior sealants.
 - 3. VOC and formaldehyde limitations for engineered wood and wood-based panel products.
 - 4. Common VOC requirements for flooring.
 - 5. Common VOC requirements for acoustical ceiling tiles and wall 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. Acoustical Panel Ceilings: Section 09 51 13.
 - 4. Paints and Coatings: Section 09 90 00.
 - 5. Sections in Divisions 01 through 49 specify indoor environmental quality requirements specific to the Work of each of those Sections. .

1.02 REFERENCES

- A. Reference Standards: Comply with the following except as otherwise specified in this Project Manual.
 - 1. California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 2. South Coast Air Quality Management District (SCAQMD) Rule No. 1168.
- B. Definitions:
 - 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.

1.03 SUBMITTALS

- A. 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. Provide documentation that composite wood and agrifiber products contain no urea-formaldehyde resins.

PART 2 PRODUCTS

2.01 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.

2.02 ADHESIVES

- A. Provide low VOC types as recommended by the manufacturer of the material being installed. Adhesives shall comply with SCAQMD Rule 1168 and the IgCC.
- B. 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. Indoor Carpet Adhesives: 50 g/L
 - 2. Carpet Pad Adhesives: 50 g/L
 - 3. Outdoor Carpet Adhesives: 150 g/L
 - 4. Wood Flooring Adhesive: 100 g/L
 - 5. Rubber Floor Adhesives: 60 g/L
 - 6. Subfloor Adhesives: 50 g/L
 - 7. Ceramic Tile Adhesives: 65 g/L
 - 8. VCT And Asphalt Tile Adhesives: 50 g/L
 - 9. Dry Wall And Panel Adhesives: 50 g/L
 - 10. Cove Base Adhesives: 50 g/L
 - 11. Multipurpose Construction Adhesives: 70 g/L
 - 12. Structural Glazing Adhesives: 100 g/L
 - 13. Single-Ply Roof Membrane Adhesives: 250 g/L
 - 14. CPVC Solvent Cement: 490 g/L
 - 15. PVC Solvent Cement: 510 g/L
 - 16. ABS Solvent Cement: 325 g/L
 - 17. Plastic Cement Welding: 250 g/L
 - 18. Adhesive Primer For Plastic: 550 g/L
 - 19. Contact Adhesive: 80 g/L
 - 20. Special-Purpose Contact Adhesives (Contact Adhesives That Are Used to Bond Melamine-Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L
 - 21. Structural Wood Member Adhesive: 140 g/L

2.03 SEALANTS

- A. For interior applications use sealants that comply with the following limits for VOC content when calculated according to SCAQMD Method 304, 316A or 316B:
 - 1. Architectural Sealants: 250 g/L
 - 2. Architectural Sealant Primer:
 - a. Nonporous: 250 g/L
 - b. Porous: 775 g/L
 - 3. Modified Bituminous Sealant Primer: 500 g/L
 - 4. Other Sealant Primers: 750 g/L

2.04 PAINTS AND COATINGS

- A. For interior applications use paints, stains, and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24) and the following chemical restrictions:
1. Flat Coatings: 50 g/L.
 2. Nonflat Coatings: 100 g/L.
 3. Nonflat - High Gloss Coatings: 150 g/L.
 4. Basement Special Coatings: 400 g/L.
 5. Bond Breakers: 350 g/L.
 6. Concrete Curing Compounds: 350 g/L.
 7. Concrete/Masonry Sealers: 100 g/L.
 8. Dry-Fog Coatings: 150 g/L.
 9. Faux Finishing Coatings: 350 g/L.
 10. Fire-Resistive Coatings: 350 g/L.
 11. Floor Coatings: 100 g/L.
 12. Form-Release Compounds: 250 g/L.
 13. Graphic Arts Coatings (Sign Paints): 500 g/L.
 14. High-Temperature Coatings: 420 g/L.
 15. Industrial Maintenance Coatings: 250 g/L.
 16. Low Solids Coatings: 120 g/L.
 17. Magnesite Cement Coatings: 450 g/L.
 18. Mastic Texture Coatings: 100 g/L.
 19. Metallic Pigmented Coatings: 500 g/L.
 20. Multi-Color Coatings: 250 g/L.
 21. Pretreatment Wash Primers: 420 g/L.
 22. Primers, Sealers, and Undercoaters: 100 g/L.
 23. Reactive Penetrating Sealers: 350 g/L.
 24. Recycled Coatings: 250 g/L.
 25. Rust-Preventive Coatings: 250 g/L.
 26. Shellacs, Clear: 730 g/L.
 27. Shellacs, Pigmented: 550 g/L.
 28. Stains: 250 g/L.
 29. Stone Consolidants: 450 g/L.
 30. Swimming Pool Coatings: 340 g/L.
 31. Tub and Tile Refinish Coatings: 420 g/L.
 32. Waterproof Membranes: 250 g/L.
 33. Wood Coatings: 275 g/L.
 34. Wood Preservatives: 350 g/L.
 35. Zinc-Rich Primers: 340 g/L.

2.05 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.

2.06 ACOUSTICAL CEILINGS

- A. Acoustic ceilings 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.

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 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.

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.
 - 7. Patch floor finish to match existing.
- B. Related Requirements:
 - 1. Alteration Project Procedures: Section 01 35 16.
 - 2. Selective Interior Demolition: Section 02 41 19.16.
 - 3. Trenching and Backfill: Section 31 23 33.

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.
 - 5. Core Drilling Through Structural Concrete Floors:
 - a. Coordinate exact location of core drilling with Architect before core drilling or cutting structural concrete floor.
 - b. Do not core drill or cut concrete joist stems or beams. Drilling will be allowed only at approved locations through thinner areas of concrete slab.
 - c. Do not proceed with drilling until Architect's approval of exact location has been received.
- 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:
 - 1. 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.
 - 2. Patch flooring to match existing.
- 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 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:
 - From Contractor
 - From Sub Contractor(s)
 - From Major material Supplier(s)
 - 2. Affidavit of Debts and Claims Payment on AIA Form G-706:
 - From Contractor
 - 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 advice 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 cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
 1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
 2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or shop Drawings.
 3. Note related change Order numbers where applicable
 4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
- 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 vinyl-covered 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 "Temporary Facilities".
- 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. Remove waste materials from the site and dispose of in a lawful manner.
 - 1. 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 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 "Project Closeout."
- 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 required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

DIVISION 02 – EXISTING CONDITIONS

SECTION 02 41 19.16

SELECTIVE INTERIOR DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

A. Work Results:

1. 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, air register, HVAC equipment, access panels, and curtain wall track 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. Use of Premises: Section 01 10 00 Summary.
2. Alteration Project Procedures: Section 01 35 16.
3. Barricades, Warning Lights and Signs: Section 01 50 00 Temporary Facilities and Controls.
4. Removal and Salvage of Construction Materials: Section 02 42 00.

1.02 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and store as specified in Section 02 42 00.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated under Section 02 42 00.
- D. 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.

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.
- 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.

PART 2 PRODUCTS – Not Used

PART 3 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. On completion, remove partitions and repair damaged surfaces to match adjacent surfaces.
 - 5. 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 74 19.
- 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

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 relocated in new construction.
 - 2. Store and protect items noted to be saved or relocated.
- B. Related Requirements:
 - 1. RCP Demolition Notes on Drawings.
 - 2. Selective Interior Demolition: Section 02 41 19.16.

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 and Materials to be Reused: All 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. Casework soffit.
 - 2. Portion of acoustical panel ceiling as indicated.

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, AND EXISTING EXTERIOR IMPROVEMENTS

- 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 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bars for cast-in-place concrete.
 - 2. Doweling Into existing concrete.

1.02 REFERENCES

- A. Reference Standards: See Section 01 42 00. Comply with listed reference standards except as modified by supplemental requirements on the Drawings or by these Specifications.
 - 1. ACI 117-10 – Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301-10 – Specifications for Structural Concrete.
 - 3. ACI 548.12-12 - Specification for Bonding Hardened Concrete and Steel to Hardened Concrete with an Epoxy Adhesive.
- B. Guide References and Standard Practices:
 - 1. SP-66(04) – ACI Detailing Manual 2004.
 - 2. CRSI MSP - Manual of Standard Practice of the Concrete Reinforcing Steel Institute, 2009, 28th edition.

1.03 COORDINATION

- A. Multi-Section Assembly Coordination Requirements: Coordinate the work of this Section with work under the following Sections to provide complete assemblies indicated on the Drawings.
 - 1. Fill for Existing Holes in Slab: Section 03 30 53 Miscellaneous Cast-In-Place Concrete.

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 current product literature for the following.
 - 1. Epoxy bonding adhesive. Include ICC-ES Report.

PART 2 PRODUCTS

2.01 REINFORCING STEEL

- A. Reinforcing Bars: ASTM A615, Grade 60, unless otherwise indicated on Structural Drawings.
 - 1. Dowels to be Adhesively Bonded Into Hardened Concrete: Embedded portions shall be straight and free of mill scale, rust and other coatings that may impair the bond with the adhesive.

2.02 ACCESSORIES

- A. Bonding Adhesive for Drilled-In Dowels:
 - 1. Basis of Design Manufacturer and Product: See Structural Drawings.
 - a. Hilti Inc.; www.us.hilti.com – HIT RE 500 SD Post-Installed Reinforcing Bar System with two-component epoxy. Refer to ICC ESR-2322.
 - b. Substitution Requests: Required for all proposed adhesive manufacturers and products not named as Acceptable Manufacturer and Product in this Section or on Drawings.
 - 1) Submit in accordance with Section 01 25 00.

PART 3 EXECUTION

3.01 PREPARATION

- A. Reinforcement: Clean prior to placing concrete to remove oil, soil, ice or other coatings that will destroy or reduce bond.

3.02 PLACEMENT

- A. General: Comply with General Notes on Structural Drawings and ACI 318.
- B. Bending:
 - 1. Bend reinforcement cold.
 - 2. Provide full-length bars, accurately bent to details by fabricator.
 - 3. Do not field-bend bars partially embedded in concrete except as indicated on the Drawings or specifically permitted by the Architect. Do not field-bend dowels adhesively bonded to concrete.
- C. Placing:
 - 1. Place reinforcement accurately and hold firmly in place before and during the placing of concrete.
 - 2. Provide minimum concrete protective cover for reinforcement from the exterior face of members in accordance with ACI 318 and notes on Drawings.
 - 3. Tolerances: Comply with ACI 117.

3.03 DOWELING INTO EXISTING CONCRETE

- A. General: Comply with applicable ICC-ES report (ES-ESR) and ACI 548.12.
- B. Drilling:
 - 1. Drill holes into existing concrete as indicated using drill bit diameter and other tools specified in ICC ES-ESR for applicable reinforcing bar size.
 - 2. Do not drill through existing reinforcement without prior approval of Architect.
- C. Surface Preparation:
 - 1. Holes: Clean out dust, foreign particles and disintegrated materials for full depth of holes.
 - 2. Dowels: Clean to bare metal, free of dust, grease, scale and any other foreign materials on surface of dowel to be bonded.
- D. Adhesive Application and Dowel Insertion:
 - 1. Comply with Manufacturer's instructions, including contact time and temperature limitations.
 - 2. Insert dowels providing full embedment indicated on Drawings and within permitted embedment depth range scheduled in ICC ES-ESR.
 - 3. Fill entire annular space with adhesive.

- E. Protection: Maintain within adhesive manufacturer's recommended temperature range and protect bars from disturbances for minimum 24 hours after installation. Do not place new adjacent concrete until adhesive is fully cured.

3.04 SITE QUALITY CONTROL

- A. Inspection:
 - 1. Notify Architect and Structural Engineer at least 48 hours before reinforcing steel installation is ready for inspection.
- B. Special Inspection: See General Notes on Structural Drawings and Section 01 45 20 Quality Control. Special Inspection is required for the following work under this Section.
 - 1. Adhesive bonding of dowels into existing concrete.

END OF SECTION

SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Patching and infilling concrete floor slabs as indicated or required to complete the Work.
- B. Related Requirements:
 - 1. Selective Interior Demolition: Section 02 41 19.16.
 - 2. Concrete Reinforcing: Section 03 20 00.

1.02 REFERENCES

- A. Reference Standards: Comply with following except as modified by supplementary requirements of this Project Specification.
 - 1. American Concrete Institute (ACI) Standards:
 - a. ACI 301-10 - Specifications for Structural Concrete.
 - d. ACI 308.1-11 – Standard Specification for Curing Concrete.
 - 2. ASTM International Standards:
 - a. ASTM C94/C94M – Ready-Mixed Concrete.
 - b. Other ASTM standards as referenced in this Section
- B. Guide References and Standard Practices: Comply with recommendations of the following except as otherwise specified in this Project Manual.
 - 1. ACI 211.5R-01 – Guide for Submittal of Concrete Proportions.
 - 2. ACI 309R-05 – Guide for Consolidation of Concrete.

1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Design Data:
 - 1. Concrete Mix Designs: Not less than two (2) weeks prior to placing any concrete, submit concrete mixes for acceptance in accordance ACI 211.5R. Separate mix design shall be submitted for each type of concrete to be used in the Project. Submittals shall include all information used in designing the mixes. See Mixes in Part 2 for design requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Ready-Mixed Concrete: Materials handling and batching shall conform to applicable provisions of ASTM C94.
 - 1. Hauling Time: Discharge concrete transmitted in truck mixer, agitator or other transportation device within 1-1/2 hours after mixing water has been added.
 - 2. Deliver concrete to site in exact proportions required by design mix.
 - 3. Extra Water: Should extra water be required for workability before depositing concrete and water/cementitious material ratio of accepted mix design will not be exceeded thereby, General Contractor's superintendent shall have sole authority to authorize addition of water.
 - a. Additional water added to mix after leaving batch plant shall be indicated on truck ticket and signed by person responsible.

- b. Where extra water is added to concrete it shall be mixed thoroughly for 50 revolutions of drum before depositing.
- c. Water may be added at the site only once for each batch.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Concrete Materials:
 - 1. General: Provide ready-mixed concrete conforming with ANSI/ASTM C94. On-job mixed concrete will not be allowed.
 - 2. Cement: ANSI/ASTM C150, Type I/II.
 - 3. Aggregate: Fine aggregate shall be natural sand and coarse aggregate shall be gravel or crushed stone, all conforming to ASTM C33. Maximum coarse aggregate size shall be determined by the thickness of members, finish required, and spacing of reinforcement and shall be approved by the Architect prior to placing any concrete.
 - 4. Water-Reducing Admixtures: ANSI/ASTM C494.

2.02 MIXES

- A. Design: Proportion ingredients for mixes in accordance with ACI 301. Obtain this information in accordance with the latest ASTM specifications.
- B. Admixtures: No admixtures will be allowed except as specified herein, unless authorized by the Architect. Requests for approval or substitution must be accompanied by sufficient information and test data for evaluation.
- C. Slump: Design mix to provide slumps indicated under mix type.
- D. Mixing: Add aggregate and approximately two-thirds of the required water to the mixer first and mix a minimum of 70 revolutions at mixing speed to insure wetting of all the aggregate particles, at which time the cement, add the air entraining agent and the remaining water and mix a minimum of 30 revolutions of mixing speed.

2.03 CONCRETE MIX TYPES

- A. Concrete Design Mix Schedule: In addition to all requirements indicated by General Notes on Structural Drawings, design mix for each concrete component or application to meet the following criteria.

Mix For Slab Infill and Miscellaneous Concrete:
3,000 psi minimum compressive strength at 28 days.
3/4-inch maximum aggregate size.
No air entraining admixture.
4-inch maximum slump.
Minimum Cement Content: 5-1/2 sack mix.

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 concrete. Do not begin placement until approval of Architect is obtained.

3.02 PREPARATION

- A. Do not begin concrete work until operations are complete enough to allow placement to be carried on as a continuous operation for the entire section that is to be placed. Clean equipment for mixing and transporting the concrete.
- B. Protection: Cover masonry walls, glazing, and other finish materials with polyethylene or otherwise protect from damage due to pouring of concrete.

3.03 PLACING CONCRETE

- A. General: Comply with ACI 301.
- B. Placement: Chuting in such a manner to separate the aggregates will not be permitted. Concrete shall not be dropped over 4'-0".
- C. Water: Prevent accumulations of water on the surface of the concrete due to water gain, segregation, or other causes, during placement or compacting, as far as possible by adjustments in the mixture. Make provision for removal of such water as may accumulate so that under no circumstances will concrete be placed in such accumulation.
- D. Compaction: Compact concrete during and immediately after placing.

3.04 FLATWORK

- A. General: Comply with ACI 301 5.3.4.
- B. Screeding: Screed and consolidate surfaces to shape slabs to indicated grades and elevations. 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.
- C. Troweling:
 - 1. Floor Slabs: 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 hand-troweling until a ringing sound is produced as the floor is troweled.
- D. Floor Flatness Tolerances: Floor slabs shall be level within following maximum tolerances measured with 10-foot long straightedge, except slope to drains as indicated.
 - 1. Floor Slabs: 1/4-inch in 10 feet.
- E. 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 AND PROTECTION

- A. Horizontal Surfaces: Keep the concrete surfaces continuously wet. Do not allow alternate wetting and drying of concrete surfaces.
- B. Final curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing.
- C. Moisture Retaining Cover Method:
 - 1. Cover all exposed fresh concrete surfaces and beyond the edge of the concrete surface with a white polyethylene sheeting of a minimum of 6 mil nominal thickness, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 2. Keep the concrete continuously wet under the sheeting.
 - 3. Keep sheeting in place a minimum of 7 days.
- D. Protection: Protect exposed surfaces of concrete from premature drying. Protect the concrete from damaging mechanical disturbances during the curing period. Protect finished surfaces from damage by construction equipment, materials or methods, application of curing procedures, or by running water. Protect concrete surfaces from staining, cracking, chipping, and other damage during progress of the work, and leave in good condition upon completion.

3.06 MISCELLANEOUS CONCRETE REQUIREMENTS

- A. Other Concrete Work: Furnish and install other concrete work indicated on the Drawings, even though not specifically mentioned herein to complete the work.

3.07 SITE QUALITY CONTROL

- A. Record of Work: Keep a record listing the time and date of placement of concrete. Such record shall be kept until the completion of the Project and shall be available to the Architect for examination at any time.

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. Mechanical Expansion Anchors for Electrical Items and Supports: Division 26 Electrical.

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 65 00 and Section 01 66 00.
 - 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 Structural 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 - 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.
 - 4. 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 Structural 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 – HIT RE 500-SD Adhesive Anchoring System with two-component epoxy with threaded rod anchors. Refer to ICC ESR-2322.
 - 2. ITW Red Head division of Illinois Tool Works; www.itwredhead.com – Epcon G5 Adhesive Anchoring System with two-component epoxy and threaded rod anchors. Refer to ICC ESR-1137.
 - 3. Powers Fasteners; 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 – Set-XP Epoxy Adhesive Anchors with two-component 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. Testing, General: See Section 01 45 20.

- B. Testing of Post-Installed Anchors: . Quality control testing shall be performed by independent testing agency in consultation with manufacturer's representative.
 - 1. Testing: Comply with Expansion Anchor Bolt Notes on Structural 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 40 00

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural metal stud framing, vertical and horizontal.
 - 2. Metal stud braces.
 - 3. Deflection tracks.
 - 4. Other structural metal stud framing as indicated.

1.02 REFERENCES

- A. Reference Standards: See Section 01 42 00. Comply with following:
 - 1. ANSI/AISI Standards:
 - a. AISI S100-2012 - North American Specification for the Design of Cold-Formed Steel Structural Members.
 - b. AISI S200-12 – North American Standard for Cold-Formed Steel Framing – General Provisions.
 - c. AISI S201-12 – North American Standard for Cold-Formed Steel Framing – Product Data.
 - 2. American Welding Society (AWS) Standards:
 - a. AWS D1.3/D1.3M:2008 – Structural Welding Code - Sheet Steel.
 - 3. ASTM C955 - Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases.
 - 4. Steel Stud Manufacturers Association (SSMA) – Product Technical Information.

1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, action and return in accordance with Section 01 33 00.
- B. Product Data: Submit two copies of manufacturer's current catalog literature and installation instructions for each product specified under this Section with all materials and accessories plainly identified.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Allied Studco; www.studco.com.
 - 2. California Expanded Metal Products Company (CEMCO); www.cemcosteel.com.
 - 3. ClarkDietrich Building Systems LLC, www.clarkdietrich.com.
 - 4. MarinoWARE; www.marinoware.com.
 - 5. Angeles Metal Systems.
- B. Substitution Requests: In accordance with Section 01 25 00.

2.02 MATERIALS

- A. Steel Mechanical Properties: Conform to requirements of AISI Specification, Section A3.
 - 1. Minimum Yield Point for Material 16 Gage to 10 Gage in Thickness: 50,000 psi.
 - 2. Minimum Yield Point for Material 18 Gage and Less in Thickness: 33,000 psi.
- B. Steel Sectional Properties and Design: Computed in accordance with AISI Specification.
- C. Steel Studs, Tracks, Bracing, Bridging and Related Metal: ASTM C955.
 - 1. Sizes and locations as indicated on Drawings.
- D. Blocking: 16 gage by 6-inch, 50 ksi sheet metal, unless heavier gage is indicated on Drawings.
- E. Finish: Corrosion resistant galvanized coating conforming to ASTM A653, G60 minimum.

2.03 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: ASTM A90, hot-dip galvanized.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Connections: Screwed as indicated on the Structural Drawings.

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. Mechanical Expansion Anchors for Electrical Items and Supports: Division 26 Electrical.

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 65 00 and Section 01 66 00.
 - 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 Structural 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 - 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.
4. 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 Structural 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 – HIT RE 500-SD Adhesive Anchoring System with two-component epoxy with threaded rod anchors. Refer to ICC ESR-2322.
2. ITW Red Head division of Illinois Tool Works; www.itwredhead.com – Epcon G5 Adhesive Anchoring System with two-component epoxy and threaded rod anchors. Refer to ICC ESR-1137.
3. Powers Fasteners; 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 – Set-XP Epoxy Adhesive Anchors with two-component 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. Testing, General: See Section 01 45 20.

- B. Testing of Post-Installed Anchors: . Quality control testing shall be performed by independent testing agency in consultation with manufacturer's representative.
 - 1. Testing: Comply with Expansion Anchor Bolt Notes on Structural 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 40 00

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural metal stud framing, vertical and horizontal.
 - 2. Metal stud braces.
 - 3. Deflection tracks.
 - 4. Other structural metal stud framing as indicated.

1.02 REFERENCES

- A. Reference Standards: See Section 01 42 00. Comply with following:
 - 1. ANSI/AISI Standards:
 - a. AISI S100-2012 - North American Specification for the Design of Cold-Formed Steel Structural Members.
 - b. AISI S200-12 – North American Standard for Cold-Formed Steel Framing – General Provisions.
 - c. AISI S201-12 – North American Standard for Cold-Formed Steel Framing – Product Data.
 - 2. American Welding Society (AWS) Standards:
 - a. AWS D1.3/D1.3M:2008 – Structural Welding Code - Sheet Steel.
 - 3. ASTM C955 - Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases.
 - 4. Steel Stud Manufacturers Association (SSMA) – Product Technical Information.

1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, action and return in accordance with Section 01 33 00.
- B. Product Data: Submit two copies of manufacturer's current catalog literature and installation instructions for each product specified under this Section with all materials and accessories plainly identified.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Allied Studco; www.studco.com.
 - 2. California Expanded Metal Products Company (CEMCO); www.cemcosteel.com.
 - 3. ClarkDietrich Building Systems LLC, www.clarkdietrich.com.
 - 4. MarinoWARE; www.marinoware.com.
 - 5. Angeles Metal Systems.
- B. Substitution Requests: In accordance with Section 01 25 00.

2.02 MATERIALS

- A. Steel Mechanical Properties: Conform to requirements of AISI Specification, Section A3.
 - 1. Minimum Yield Point for Material 16 Gage to 10 Gage in Thickness: 50,000 psi.
 - 2. Minimum Yield Point for Material 18 Gage and Less in Thickness: 33,000 psi.
- B. Steel Sectional Properties and Design: Computed in accordance with AISI Specification.
- C. Steel Studs, Tracks, Bracing, Bridging and Related Metal: ASTM C955.
 - 1. Sizes and locations as indicated on Drawings.
- D. Blocking: 16 gage by 6-inch, 50 ksi sheet metal, unless heavier gage is indicated on Drawings.
- E. Finish: Corrosion resistant galvanized coating conforming to ASTM A653, G60 minimum.

2.03 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: ASTM A90, hot-dip galvanized.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Connections: Screwed as indicated on the Structural Drawings.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Steel angles for connections of partition braces to underside of floor deck above.
 - 2. All other 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. Cold-Formed Metal Framing: Section 05 40 00.
 - 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 360-10 - 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:2015 – 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 65 00 and Section 01 66 00.

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 MATERIALS

A. Carbon Steel Shapes, Bars and Plates: ASTM A36.

B. Steel Pipe and Tubing: ASTM A53, Grade B, or A500, Grade B, minimum wall thickness 11 gage.

C. Threaded Rod: ASTM A36.

D. Steel Fasteners and Anchors:

1. Bolts: ASTM A325.
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 Paint:
 1. Steel Items to Receive Painted Finish or To Be Concealed in Completed Structure: One of the following.
 - a. Tnemec Series 10 modified alkyd primer.
 - b. Society for Protective Coatings Specification SSPC Paint 25 lead and chromate free primer.
- B. 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: SP-3 power tool cleaning.
 - b. Surfaces to be Exposed in the Completed Structure: SP-6 commercial blast cleaning.
 2. Paint Application: Shop coat fabricated items with shop paint in accordance with SSPC-PA-1.
 - a. Omit shop paint on surfaces to be enclosed in concrete and surfaces to be field welded.
 - b. Standard Shop Paint Thickness: 2.5 dry film mils.

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

SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous blocking and supports.
 - 2. Miscellaneous wood sheathing.
 - 3. Fire-retardant treatment.
- B. Related Requirements:
 - 1. Architectural Wood Casework: Section 06 41 00.

1.02 REFERENCES

- A. Reference Standards. See Section 01 42 00. Comply with the following:
 - 1. Wood Framing: Comply with requirements of the 2013 California Building Code and ANSI/AF&PA NDS-2012 National Design Specification for Wood Construction, as published by the American Wood Council of the American Forest and Paper Association.
 - 2. Lumber: Grading Rules for Lumber, latest edition, as published by Western Wood Products Association.
 - 3. Plywood: National Institute of Standards and Technology (NIST) – Voluntary Product Standard PS 1-09 - Structural Plywood.
 - 4. Performance Rated Wood Sheathing Panels:
 - a. APA PRP-108 - Performance Standards and Policies for Structural-Use Panels.
 - b. National Institute of Standards and Technology (NIST) – Voluntary Product Standard PS 2-10 – Performance Standard for Wood-Based Structural-Use Panels.
 - 5. Treatment:
 - a. AWPA C2 – Lumber, Timber, Bridge Ties and Mine Ties – Preservative Treatment by Pressure Processes.
 - b. AWPA C20 – Structural Lumber – Fire-Retardant Treatment by Pressure Process.
 - c. AWPA C27- Plywood – Fire-Retardant Treatment by Pressure Process.
 - d. AWPA P5 – Standard for Waterborne Preservatives.
 - e. AWPA Standard P17 - Fire Retardant Formulations.
 - f. AWPA Use Category System, Appendix H.

1.03 QUALITY ASSURANCE

- A. Grade Stamps:
 - 1. Lumber: Each piece shall be WWPA or WCLIB grade stamped.
 - 2. Wood Sheathing: Each panel shall be identified with the grade trademark of the APA.
 - 3. Lumber Specified to be Preservative Treated: Each piece shall be stamped to indicate compliance with AWPA pressure treatment standards.
- B. Treatment Labels: Label each piece of treated lumber.
 - 1. Fire Treated Lumber: UL labels.

1.04 DELIVERY, STORAGE, AND HANDLING

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

- B. Storage: Stack all materials minimum of 6 inches above ground to ensure proper ventilation and cover with waterproofing covering.

PART 2 PRODUCTS

2.01 WOOD MATERIALS

- A. General Requirements:
 - 1. Lumber: Sound, thoroughly seasoned, surfaced four sides, well manufactured and free from warp not correctable by bridging, blocking or nailing.
 - 2. Moisture Content: Provide dry lumber as defined by the American Softwood Lumber Standard PS 20, with moisture content limited to maximum 19 percent moisture content, graded S-DRY, KD or KD-HT, as documented by grade stamp.
 - 3. Dimension Lumber Noted on Drawings to be Non-Combustible: Fire retardant treated with chloride salts.
- B. Blocking, Furring and Miscellaneous Dimension Lumber: Douglas Fir-Larch or Hem-Fir. Standard Grade or Better.
- C. Miscellaneous Panels for Interior Application: APA plywood BDX interior with exterior glue. 3/4-inch thickness unless otherwise indicated.
 - 1. Electrical Component Mounting: Fire retardant treated.

2.02 TREATMENT

- A. Fire Retardant Treated Plywood: All sheathing required to be fire retardant-treated shall be pressure-treated in accordance with AWPA Standard C27 with an approved low hygroscopic, high temperature Interior Type A-HT fire retardant.
 - 1. Each panel shall be labeled or marked by an approved independent testing agency.
 - 2. After treatment, plywood shall be dried to an average moisture content of 15 percent or less.

2.03 FASTENERS, ANCHORS AND HARDWARE

- A. General: Provide necessary bolts, screws, nails, clips, plates, straps, hangers, etc. necessary for completion of rough carpentry. Provide correct material of proper size and strength for purpose intended conforming to specifications, drawings and applicable building codes. Supply anchors to be cast into concrete and masonry for anchorage of wood for installation under other Sections.
- B. Exterior Applications: Provide fasteners hot dip galvanized in accordance with ASTM A153.
- C. Fasteners for Use in Pressure Treated Wood: One of the following:
 - 1. Stainless steel.
 - 2. Steel, hot-dip galvanized to G185 in accordance with ASTM A653.
 - 3. Steel, Batch/Post Hot-Dip Galvanized in accordance with ASTM A153.
 - 4. Steel, mechanically galvanized to Class 55 or greater in accordance with ASTM B695.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Verify that surfaces to receive rough carpentry are prepared to required grades and dimensions.

3.02 INSTALLATION

- A. General:
 - 1. Perform in substantial manner consistent with accepted standards of carpentry trade.
 - 2. Framing: Erect plumb, level and true and rigidly anchor in place. Cut framing square on bearings, closely fit, accurately set to required lines and levels.
 - 3. Nail or spike members in accordance with IBC and General Structural Notes on Drawings.
 - 4. Framing: 16 inches on center unless otherwise indicated.
 - 5. Shims: Do not use shims for leveling on wood or metal bearings. Use steel shims with full bearing on masonry or concrete.
 - 6. Metal Framing Anchors: Install where required for proper connections in accordance with manufacturer's recommendations.
- B. Anchors: Unless otherwise indicated, bolt plates firmly to concrete or masonry with 3/8-inch by 12 inches (3-inch horizontal leg) anchor bolts, 2'-0" on center or use powder-actuated fastening system.
 - 1. Size and Spacing: Accepted by Architect.

3.03 WOOD BLOCKING AND MISCELLANEOUS LUMBER REQUIRED FOR WORK OF OTHER SECTIONS

- A. General: Cooperate with other trades. Provide required grounds, blocking, wood backing and framing. Perform necessary cutting and patching of rough carpentry work as required.
- B. Interior Blocking: Install blocking of size required for support of handrails, toilet and bath accessories, wall-mounted door stops, wall cabinets and other wall-mounted accessory items. Set true to line, level or plumb well secured in stud wall and flush with back of drywall or other wall finish.

END OF SECTION

SECTION 06 41 00

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Modifying and patching existing casework as indicated on Drawings.
- B. Related Requirements:
 - 1. Base Cabinet Anchors: Section 05 05 23 Post-Installed Concrete Anchors.
 - 2. Metal Blocking: Section 05 40 00 Cold-Formed Metal Framing.
 - 3. Door Hardware: Section 08 71 00.
 - 4. Solid Surfacing Countertops: Section 12 36 61 Simulated Stone Countertops.
 - 5. Plumbing Fixtures: Division 22.

1.02 REFERENCES

- 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 following:
 - 1. Woodwork Institute (WI) Standards:
 - a. North American Architectural Woodwork Standards – 3.0 (NAAWS), July 1, 2016.
 - 1) Comply with Custom Grade if not otherwise specified.
 - 2) Seismic Installation Requirements: Annex 10E.
 - 2. American National Standards Institute (ANSI);
 - a. ANSI A135.4-2012 – Basic Hardboard.
 - b. ANSI/BHMA A156.9-2010 - American National Standard for Cabinet Hardware.
 - c. ANSI A208.2-2016 - Medium Density Fiberboard (MDF) for Interior Applications.
 - d. ANSI/NPA A208.1-2009 – Particleboard.

1.03 COORDINATION

- A. Blocking and Backing Anchorage: Coordinate with work under other Sections to ensure proper blocking and backing is installed in walls where anchorage of casework must meet seismic requirements. Ensure minimum blocking as follows:
 - 1. For Metal Stud Walls: 16 gage by 6-inch, 50 ksi sheet metal.

1.04 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Submit catalog data for all countertop surfacing materials, countertop setting and grouting materials, shelving and shelving hardware.

- C. Shop Drawings: Comply with NAAWS Section 1.
 - 1. Cabinets and Casework: Submit shop drawings for plastic faced casework and countertops showing layout, elevations, ends, cross sections, service run spaces, and location of services. Show details and location of anchorages and fitting to floors, walls and base. Indicate all hardware and accessory items.
 - a. Indicate materials, assembly methods, joint details, fastening methods, accessory listings, location of hardware, and schedule of finishes for each casework item.
 - 1) Include a casework fastener schedule, clearly showing the type, size, location and maximum spacing of the installation fasteners.
 - b. Include Casework elevations showing the center-line height and horizontal locations of all required, continuous, internal wall blocking installed under other Sections.
 - c. Include layout of units with relation of surrounding walls, doors, windows and other building components.
 - d. Coordinate shop drawings with other work involved.
- D. Samples: Comply with NAAWS Section 1.
 - 1. Material Samples:
 - a. Submit two 2-inch by 3-inch samples of specified plastic laminate colors, patterns and textures for exposed and semi-exposed materials for Architect's selection or verification. Samples will be reviewed by Architect for color, texture and pattern only. Compliance with other specified requirements is the exclusive responsibility of the Contractor.
 - b. Submit samples of PVC edges for color selection or verification.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Casework Fabricator:
 - a. Firm with no less than 5 years of production experience similar to this Project, whose qualifications indicate the ability to comply with the requirements of this Section.
 - b. The fabricator must have at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.
 - c. A licensee in good standing of the Woodwork Institute Certified Compliance Program.

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.
- C. 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.

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 SOLID STOCK WOOD AND PLYWOOD PANEL MATERIALS

- A. General Requirements for Interior Wood Materials:
 - 1. Solid Stock Lumber Grade: In accordance with AWI rules for Premium Grade construction with specified finish unless indicated otherwise.
 - 2. Moisture Content: Minimum 5 percent, maximum 10 percent at delivery.
- B. Millwork Material: Hardwood, select, kiln-dried.
 - 1. Species and Grade:
 - a. Paint Finish: Poplar, Birch or Maple. AWI Grade II. Clear.
 - 2. Millwork Patterns: As indicated on Drawings.

2.03 WOOD-BASED COMPOSITE PANELS

- A. Plywood:
 - 1. Plywood to Receive Plastic-Laminate: Commercial Standard Good Grade, minimum 3/4-inch thick before lamination.
 - 2. Maximum Allowable Formaldehyde Emissions: 0.05 ppm.
- B. Particleboard: ANSI A2.08.1, 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.
 - 1) Duraflake.
 - 2) NAUF Panels: Terra Particleboard.
 - 3) ULEF Panels: Vesta Particleboard.
 - b. SierraPine; www.sierrapine.com - Encore.
 - c. Accepted substitute in accordance with Section 01 25 00.
 - 3. Thickness: 3/4-inch.
 - 4. Cabinet Interiors: Acrylic coated 45-47 pound density industrial particleboard.
- C. Medium-Density Fiberboard (MDF): ANSI A2.08.2.
 - 1. Grade: Grade 155 MR-50.
 - 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.
 - 1) Premier MDF.
 - 2) NAUF Panels: Terra MDF.
 - 3) ULEF Panels: Vesta MDF.
 - b. SierraPine; www.sierrapine.com - Medite II.
 - c. Accepted substitute in accordance with Section 01 25 00.
 - 4. Thickness: 3/4-inch unless indicated otherwise.
- D. Hardboard: ANSI A135.4. Tempered Grade.

2.04 HIGH PRESSURE LAMINATES (HPL)

- A. Basis of Design HPL Overlay Manufacturer: See Finish Legend on Drawings.
 - 1. Wilsonart LLC; www.wilsonart.com.

- B. High Pressure Decorative Laminate: NEMA LD3, Grade CLS.
 - 1. Horizontal Surfaces: General Purpose Grade 10/HGS.
 - 2. Vertical Surfaces: May be Vertical Grade 55VGS.
- C. Colors: See Finish Legend on Drawings.

2.05 SOLID SURFACING

- A. Countertops: Section 12 36 61.

2.06 EDGE BAND

- A. Edgeband: PVC matching the color and pattern of the exposed laminate.

2.07 HARDWARE AND ACCESSORY ITEMS

- A. Slides:
 - 1. TCMC Facilities Management Standard Manufacturer and Products:
 - a. Accuride International, Inc., www.accuride.com.
 - b. 12-Inch to 28-Inch Drawer Slides: AC3017.
 - c. 12-Inch to 28-Inch Lateral File Slides: AC4032.
- B. Pull Handles:
 - 1. TCMC Facilities Management Standard Manufacturers and Products:
 - a. 4-Inch Handle Pulls: Fenny - FE1484 CH.
 - b. Flush Pulls: Knap and Vogt Manufacturing – KV819 Anochrome.
- C. Door and Drawer Locks:
 - 1. TCMC Facilities Management Standard Manufacturer and Products:
 - a. Drawers: National Cabinet Lock – N8178-26-KD – Keyed Different – 7/8-inch cylinder.
 - b. Doors: National Cabinet Lock – N8178-26-KD – Keyed Different – 7/8-inch cylinder.
 - c. Doors: National Cabinet Lock – N8179-26-KD – Keyed Different – 1-3/8 inch cylinder.
 - d. Pin Tumbler Sliding Door Locks: National Cabinet Lock – N8142-26-KD – Keyed Different – Dull Chrome - 1-1/8 inch cylinder.
- D. Wire Management Grommets:
 - 1. TCMC Facilities Management Standard Manufacturer and Product:
 - a. ITW Plastiglide – P3RD+Color Code – 3”..
- E. Door Catches:
 - 1. TCMC Facilities Management Standard Manufacturers and Products:
 - a. Magnetic Catches: EPCO – EP1001.
 - b. Elbow Catches: IVES – IV2AM Aluminum.
- F. Connecting Screws:
 - 1. TCMC Facilities Management Standard Manufacturers and Products:
 - a. Hettich International.
 - b. Connector: HEVSH-B.
 - c. Screw: HEVSH-C.
- G. Adjustable Shelf Pilasters:
 - 1. TCMC Facilities Management Standard Manufacturer and Product:
 - a. Knap and Vogt Manufacturing.
 - b. KV256AMNAT Aluminum Natural.

- H. Wood Shelf Standards:
 - 1. TCMC Facilities Management Standard Manufacturer and Products:
 - a. Reeve Store Equipment Company.
 - b. Single Slot: RVS40+Length.
 - c. Double Slot: RVS44+Length.
- I. Wood Shelf Supports with Angled Top:
 - 1. TCMC Facilities Management Standard Manufacturer and Products:
 - a. Reeve Store Equipment Company.
 - b. Left: RVS81-L.
 - c. Center: RVS81-C.
 - d. Right: RVS81-R.
 - 2. Description: Heavy duty, self-locking nylon or steel, designed for installation in pre drilled holes in cabinet ends and vertical partitions, designed to prevent the shelf support from rotating. No exceptions.
- J. Hinges: 5 knuckle 2-1/4 inch, overlay type, hospital tip, 0.095-inch thick steel with dull chrome, finish.
 - 1. Acceptable Manufacturers:
 - a. Blum, Inc.; www.blum.com.
 - b. Grass America, Inc.
 - c. Häfele America Co.
 - d. Hettich America LP.
 - 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.
- K. Drawer Stops: All regular drawers shall be equipped with two drawer stops attached to the cabinet ends. The cabinet drawer stops shall be metal with attached rubber bumper and be installed to prevent the drawer face from touching the cabinet ends edges when the drawer is in a closed position.
- L. Exposed Hardware Finish: Comply with BHMA A156.18.
- M. Adhesives: Provide low VOC types as recommended by the manufacturer of the material being installed. Adhesives shall comply with SCAQMD Rule 1168 VOC limits.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Comply with Section 01 71 16:
 - 1. Verify spaces are ready to receive casework. Verify grounds, blocking, backing, and supports for proper location and support of casework.
 - a. At wood or metal stud walls, prior to application of wall surfacing, examine, approve and acknowledge blocking compliance.
 - 2. Layout: Verify layout of work before beginning installation.
- B. Notification: Notify General Contractor of unsatisfactory conditions in writing with a copy to Architect.
- C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

- A. Field Measurements: Field measure spaces to receive casework before beginning fabrication.

3.03 INSTALLATION

- A. General: Install all work in conformance with the NAAWS, including Annex 10E seismic casework installation requirements.
 - 1. Installation shall conform to the Grade of the items being installed.
 - 2. All work shall be secured in place, square, plumb, and level. Provide connecting and attaching devices, closures and trim members as required.
 - a. Fastener Placement: Comply with NAAWS 10.6.4.E.
 - 3. All work abutting other building components shall be properly scribed and closely fit casework to adjacent work.
 - 4. Mechanical fasteners used at exposed and semi-exposed surfaces, excluding installation attachment screws and those securing cabinets end to end, shall be countersunk.
 - 5. Equipment cutouts shown on plans shall be cut by the installer.
- B. Counters: Construct supports for counters as indicated.
 - 1. Securely attach counters to walls plumb and level.
 - 2. Sinks, Trim, Electrical Devices: Provided and installed under other sections.
 - 3. Simulated Stone Countertops: Installed under Section 12 36 61.
- C. Cabinet Bases: Construct cabinet bases for cabinets as indicated and securely anchor to floor.

3.04 ADJUSTING

- A. Before completion of the installation, the installer shall adjust all moving and 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.

3.05 CLEANING

- A. Clean plastic surfaces, repair minor damage per plastic laminate manufacturer's recommendations. Replace other damaged parts or units.

3.06 PROTECTION

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

END OF SECTION

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 26 16

BELOW-GRADE VAPOR RETARDERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Continuous vapor retarder under interior concrete floor slab-on-grade patches.
 - 2. Compactible granular base over and under vapor retarder.
- 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. Reference Standards: Comply with following except as modified by supplementary requirements of this Project Specification.
 - 1. ASTM International Standard Specifications and Test Methods:
 - a. ASTM E154/E154M-08a(2013)e1 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
 - b. ASTM E1745-11 – Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- B. 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:
 - 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 E1643-11 – 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 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Submit copies of manufacturer's current catalog literature for underslab vapor retarders.

1.04 INFORMATIONAL SUBMITTALS

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

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. 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.

B. Storage and Handling Requirements: Comply with Manufacturer's printed instructions.

1. Vapor Retarder: Protect from damage and keep dry.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Acceptable Manufacturers and Products:

1. Barrier-Bac, Inc., www.barrierbac.com – VB-250, 11 mil, three layer, co-extruded biaxially oriented polyethylene membrane.
2. Fortifiber Corporation, www.fortifiber.com - Moistop Ultra 10, 10 mil thickness polyolefin membrane.
3. Reef Industries, Inc., www.reefindustries.com - Griffolyn 10 mil, co-extruded polyolefin membrane.
4. Stego Industries, LLC, 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 – Perminator 10 Mil Underslab Vapor Barrier, polyolefin-based membrane.

B. Substitution Requests: in accordance with Section 01 25 00.

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 GRANULAR BASE AND BLOTTER LAYER

A. Compactible Granular Base Material For Placement Over Vapor Retarder: Clean, fine-graded crusher fines or manufactured sand, having a uniform distribution of particle sizes ranging from the No. 4 through the No. 200 sieve, with 10 percent to 30 percent of particles passing a No. 100 sieve, and not contaminated with clay, silt or organic material.

B. Moisture Content: Dry. Minimum moisture content to meet compaction requirements.

2.04 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:
 - 1. Layout: Verify layout of work before beginning installation.
 - 2. 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.
 - 3. Install compactible 2-inch granular blotter layer over vapor retarder before placement of concrete.
- 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.
 - 1. Place top lap in direction of spreading of compactible granular base.
- 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.
- F. Granular Blotter Layer: Immediately prior to placement of concrete, cover vapor barrier with two inch thick uniform compactible granular material. Compact in accordance with requirements of Section 31 23 33 for granular fill under floor slabs. Protect granular layer from excessive moisture beyond minimum required for compaction until concrete is placed.

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 84 00

FIRESTOPPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Penetration firestopping, fire-resistant joint sealants, fire safing, and smoke seals as indicated on the Drawings as well as the following areas:
 - a. All openings in fire-rated floors and walls both empty and those accommodating penetrating items such as cables, cable trays, conduits, pipes, ducts, etc.
- B. Related Requirements:
 - 1. Joint Sealants: Section 07 92 00.
 - 2. Mechanical and Electrical Work: Divisions 21 through 28.

1.02 REFERENCES

- A. Guide References and Standard Practices: Comply with recommendations of the following unless otherwise specified.
 - 1. ASTM E2174-14b – Standard Practice for On-Site Inspection of Installed Fire Stops.
 - 2. ASTM E2393-10a(2015) – Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
 - 3. FCIA Firestop Manual of Practice.

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 printed product data indicating product characteristics, performance and limiting criteria for each product proposed for use.

1.04 INFORMATIONAL SUBMITTALS

- A. Procedures: Submit for information and verification in accordance with Section 01 33 00.
- B. Installation Instructions: Submit Manufacturer's installation instructions for each type of firestop required by the Project.

1.05 CLOSEOUT SUBMITTALS

- A. Procedures: Submit the following in accordance with Section 01 78 00.
- B. 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.

1.06 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer Qualifications: Firestopping shall be performed by a contractor trained or approved by firestop manufacturer.

- B. Mock-Up: Prepare job mock-up of each system proposed for use in the Project as directed by Architect. Approved mock-ups may be left in place as part of the finished Project and will constitute the standard for remaining work.

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 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.
- B. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.

1.09 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Acceptable Firestopping Manufacturers and Systems:
 - 1. 3M Fire Protection Products.
 - 2. A/D Fire Protection Systems; www.adfire.com, division of the Carboline Company – A/D Firebarrier,
 - 3. Hilti Corporation; www.us.hilti.com - Hilti Firestop Systems.
 - 4. Nelson FireStop Products; www.nelsonfirestop.com.
 - 5. The RectorSeal Corporation; www.rectorseal.com – Metacaulk Firestopping Products; www.metacaulk.com.
 - 6. Specified Technologies, Inc. (STI); www.stifirestop.com.
 - 7. Tremco Fire Protection Systems Group of Tremco Incorporated; www.tremcofirestop.com, - TREMstop.
- B. Basis of Design Fire Safing Manufacturer and Product: Thermafiber, Inc.; www.thermafiber.com - Thermafiber Safing Insulation.
 - 1. Size: As required by fire rating and conditions.
 - 2. Accessories; Provide Thermafiber Safing Clips as required.
- C. Substitution Requests: In accordance with Section 01 25 00.

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.

2.04 ACCESSORIES

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

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.

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 repellant 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

- A. Install in strict accordance with Manufacturer's printed instructions 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 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 SITE 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.

3.05 ADJUSTMENT

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

3.06 CLEANING

- A. 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.
- B. If visible in the finished work, remove temporary dams after initial cure of firestops.

- C. Correct staining and discoloring on adjacent surfaces.
- D. Remove all debris and excess materials entirely from site and leave work in a neat and clean condition.

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. Other joints as indicated.
- B. Related Requirements:
 - 1. Firestopping: Section 07 84 00.
 - 2. Glazing Sealants: Section 08 84 00 Plastic Glazing.

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 36.

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.

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 00.
 - 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, Sonolastic brand.
 - b. Geocel Engineered Polymers.
 - c. Pecora Corporation; www.pecora.com.
 - d. Sika Corporation; www.usa.sika.com.
 - e. Tremco, Inc.; www.tremcosealants.com.
 - 2. General Construction Sealants:
 - a. BASF; www.buildingsystems.basf.com, Sonneborn brand.
 - b. DAP Incorporated.
 - c. Pecora Corporation; www.pecora.com.
 - d. Sika Corporation; www.usa.sika.com.
 - e. Tremco, Inc.; www.tremcosealants.com.
 - 3. Silicone Sealants:
 - a. General Electric.
 - b. Dow Corning; www.dowcorning.com.
 - c. Pecora Corporation; www.pecora.com.
 - d. Tremco, Inc.; www.tremcosealants.com.
 - 4. Fire-Resistant Sealants:
 - a. BASF; www.buildingsystems.basf.com, Sonneborn brand.
 - b. DAP Incorporated.
 - c. Pecora Corporation; www.pecora.com.
 - d. Sika Corporation; www.sikaconstruction.com.
 - e. Tremco, Inc.; 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: 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.
 - 2. Tremco, Inc.; www.tremcosealants.com.
 - 3. United States Gypsum Co; 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 – Sonolastic.
 - 2. Backer Rod Manufacturing Inc.; 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 1/4-inch 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

DIVISION 08 – OPENINGS

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Flush hollow metal doors.
 - 2. Hollow metal door frames.
 - 3. Hollow metal window frames.
- B. Related Requirements:
 - 1. Access Panels: Section 08 31 00 Access Doors and Panels.
 - 2. Hardware including Thresholds and Weatherstripping: Section 08 71 00 Door Hardware.
 - 3. Plastic Glazing: Section 08 84 00.

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 National Standards Institute (ANSI):
 - a. ANSI A115 - Specifications for Door and Frame Preparation for Hardware.
 - 2. National Fire Protection Association (NFPA):
 - a. NFPA 80 - Standard for Fire Doors and Other Opening Protectives, 2016 Edition.
- C. Guide References and Standard Practices: Comply with recommendations of the following except as otherwise specified in this Project Manual.
 - 1. Hollow Metal Manufacturers Association (HMMA), a division of the National Association of Architectural Metal Manufacturers (NAAMM):
 - a. ANSI/HMMA 840-07 –Installation and Storage of Hollow Metal Doors and Frames.
 - b. ANSI/NAAMM HMMA 861-14 – Guide Specifications for Commercial Hollow Metal Doors and Frames.

1.03 COORDINATION

- A. Templates: Hardware templates for hardware mounted on hollow metal work shall be submitted under Section 08 71 00 directly to hollow metal manufacturer immediately after acceptance of hardware schedule. Report failure to receive templates with reasonable promptness to General Contractor.

1.04 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Shop Drawings: Submit drawings indicating dimensions, layout and anchorage details of all hollow metal frames.

1.05 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Section 01 77 00.
 - 1. Fire Door and Frame Assemblies: Submit documentation for Owner's records of initial inspection and approval of fire door assemblies by inspector for authority having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. General Requirements: Comply with Section 01 60 00 and with Manufacturer's recommendations.
- B. Storage and Handling Requirements:
 - 1. Store frames in manner to prevent twisting.
 - 2. Doors with dimples or dents will be rejected.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Fire Rating: Provide fire rating label acceptable to local building code authority on doors and frames indicated on the door schedule. If any door or frame scheduled to be fire-rated cannot qualify for appropriate labeling because of its design, hardware or any other reason, advise Architect prior to submission of bids.

2.02 HOLLOW METAL FRAMES

- A. General: Frames for hollow metal and wood doors, entrances, windows and borrowed lights, etc. indicated to be hollow metal shall be of design sections as detailed and assembled as indicated.
- B. Gages:
 - 1. Frames on Interior Walls: 16 gage steel.
 - 2. Loose Glazing Beads: Not less than 20 gage steel, corners butted.
- C. Construction: Construct frames encompassing one or more doors with sidelights or transoms, and steel window walls, etc., in rigid units of as large size as practical to reduce to minimum number of job-fabricated joints.
 - 1. Joints and Connections Including Job-Fabricated Joints: Welded and ground and entire assembly reinforced and braced as required to ensure absolute rigidity.
 - 2. Provide expansion joints as indicated or required.
 - 3. Where so indicated or as required, provide channel stiffening within and securely welded to frame member.
 - 4. Do not use exposed screws except where specifically accepted.
- D. Accessories:
 - 1. Reinforcement for Hardware: Machine frames for attachment of hardware, including mortising, reinforcing, drilling and tapping for hinges.
 - a. Butt Hinges: Seven gage, 12 inches long.
 - b. Closers: 10 gage, 12 inches long, full width of frame or equivalent.
 - c. Strikes, Flush Bolts and Other Surface Mounted Hardware: 12 gage or equivalent.
 - 2. Anchors: Furnish anchors of type and number required for anchoring frames to structure, partitions, etc. as follows:
 - a. Three jamb anchors on seven foot high jamb.
 - b. Four jamb anchors on jambs over seven feet.

- Wire anchors will not be allowed. Provide such installation instructions as are necessary to ensure proper installation of anchors.
3. Silencers: Drill stop of lock jamb of each interior frame for installation of pneumatic rubber door silencers. Silencers shall be furnished under Section 08 71 00, numbers as indicated on schedule.
 4. Joints: Conceal welded joints in two-sided mullions or similar sections behind glazing stops. Continuous weld and grind smooth exposed joints.
 5. Glazing Stops: Provide removable metal stops, screwed to frame, at borrowed lights and window walls. See Section 08 84 00 for glazing clearance requirements.
 - a. Unless indicated otherwise, glazing stops shall be 5/8-inch x 3/4-inch or 3/4-inch x 3/4-inch cold-rolled channel, shaped as required or detailed and hand fitted to each opening.
 - b. Butt Joints: Square and true and tightly fitted.
 - c. Fasten to frame with metal screws 18 inches on center, flathead, countersunk. Do not over-tighten to cause indentations or puckering at screws. Use vandalproof screws at exterior stops.
- E. Hinges: Install mortar protection box behind each hinge cut.

2.03 HOLLOW METAL DOORS

- A. General: Doors indicated to be hollow metal shall be hollow metal, flush, swing type doors of types indicated.
- B. Construction: Construct hollow metal doors from 16 gage steel, fully welded, ground smooth and completely sound and fire insulated. Provide thermal insulation in exterior doors. Manufacture hollow metal doors and panels with flush tops, sides and bottoms. Plastic inserts are not acceptable. All vertical seams shall be fully welded. Lock seams or epoxy filled seams are not acceptable.
- C. Labels: Provide fire rated construction and UL labels where listed in door schedule.
- D. Hardware: Mortise and reinforce doors to receive hardware.
 1. Hinges: Seven gage steel plate, 9-inches, welded to continuous 16 gage interior edge channels or equivalent. Drill and tap. Use of coined or extruded holes not acceptable.
 2. Locks, Latches, Push/Pulls and Panic Devices: 12 gage steel spot welded to 16 gage interior edge channels or equivalent and designed to provide adequate support and reinforcement for required hardware.
 3. Closers: Not less than 12 gage internal reinforcement. Provide special attention to reinforcing doors where closers are to be bolted through door.
- E. Insulation: Foam or batt type. Honeycomb core is not acceptable.
- F. Vision Lite Systems: Manufacturer's standard kits consisting of glass lite moldings to accommodate thickness and size of vision lite indicated.

2.04 FINISH

- A. Cleaning and Primer:
 1. Thoroughly clean surfaces of grease, rust and scale to insure paint adherence. Apply filler to doors where required to produce a smooth surface.
 2. Apply one coat of baked-on factory primer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Frames:
 - 1. Set steel frames accurately in accordance with details, straight and free of twist with head level and jambs plumb. Rigidly anchor to walls and partitions and securely brace until surrounding work is completed. Provide deflection clearances at frame heads where indicated.
 - 2. Field Welds: Make welds full length of joints. Remove splatter and grind exposed welds to match adjacent surfaces. Provide Architect with ample notice to review welds before finish operations begin.
 - 3. Wherever possible leave spreader bars in place until frames are securely anchored.
 - 4. Jambs shall be filled with grout where frames occur in concrete or masonry walls.
 - 5. Provide special masonry anchorage devices where required for securing hollow metal frames to in-place masonry construction. Set anchorage devices, opposite each anchor location in accordance with details on accepted shop drawings and anchorage device manufacturer's recommendations.
- B. Doors: Apply hardware in conformance with hardware manufacturer's templates and instructions. Hang doors to be free of binding with hardware functioning properly.
 - 1. Clearance Tolerances:
 - a. Head: 1/8-inch maximum.
 - b. Jamb: 1/8-inch maximum.
 - c. Between Doors (Pair): 1/8-inch maximum.
 - d. Sill without Threshold: 1/2-inch maximum.
- C. Fire-Rated Door and Frame Assemblies: Install in compliance with NFPA 80.
 - 1. Install with door clearances within limits listed in NFPA 80.
 - 2. Make no field modifications to door assembly that void the label.
- D. Miscellaneous Items: Install closures, panels, fillers, etc. as indicated.

3.02 ADJUSTING

- A. At completion of job, adjust doors and hardware as required and leave in proper operating condition. Adjust doors to freely swing, completely close, and positively latch.

END OF SECTION

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Access doors into ceiling spaces.
 - 2. Access doors into pipe and utility 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.
- B. 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 Masonry, Tile, Concrete, or Gypsum Drywall:
 - 1. Acudor Products, Inc.; www.acudor.com - Model UF-5000.
 - 2. J.L. Industries; www.jlindustries.com - Model TM.
 - 3. Karp Associates, Inc.; www.karpinc.com - Model DSC-214M.
 - 4. Milcor; www.milcorinc.com - Style M.

5. Nystrom Building Products; www.nystrom.com - Model NT.
 6. Williams Brothers Corporation of America; www.wbdoors.com – WB Series.
 7. Substitution Requests: In accordance with Section 01 25 00.
- B. Sizes: As indicated on Drawings or as required to properly service mechanical or electrical equipment.
- C. Material: Stainless steel.
- D. Finish:
1. Stainless Steel: No. 4 satin finish.
- E. Locking Devices: Key operated cam locks.

2.02 RECESSED ACCESS DOORS

- A. 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 - Model DW-5015.
 2. Karp Associates, Inc.; www.karpinc.com - Model RDW.
 3. Nystrom Building Products; www.nystrom.com - Model RW.
 4. Williams Brothers Corporation of America; www.wbdoors.com - WB-RDW.
 5. Substitution Requests: In accordance with Section 01 25 00.
- B. Acceptable Manufacturers and Products - Non-Rated Access Doors, Recessed for Installation of Acoustical Ceiling Tile:
1. Acudor Products, Inc.; www.acudor.com - Model AT-5020.
 2. Karp Associates, Inc.; www.karpinc.com - Model DSC-210.
 3. Milcor; www.milcorinc.com - Style CT.
 4. Nystrom Building Products; www.nystrom.com - Model RA.
 5. Williams Brothers Corporation of America; www.wbdoors.com - WB-AT.
 6. Substitution Requests: In accordance with Section 01 25 00.
- C. Sizes: As indicated on Drawings or as required to properly service mechanical or electrical equipment.
- D. Material: Stainless steel.
- E. Finish:
1. Stainless Steel: No. 4 satin finish.
- F. 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 - Model FB-5050.
 2. Karp Associates, Inc.; www.karpinc.com – Model KRP-150 FR.
 3. J.L. Industries; www.jlindustries.com- Model FD.
 4. Milcor; www.milcorinc.com – Style UFR.
 5. Nystrom Building Products; 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 UL or Warnock Hersey International for 20 minutes.
- 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: Key operated cam locks.

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

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:

a. Swinging doors.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

- 1. Windows**
- 2. Cabinets (casework), including locks in cabinets**
- 3. Signage**
- 4. Toilet accessories**
- 5. Overhead doors**

C. Related Sections:

- 1. Division 01 Section "Alternates" for alternates affecting this section.**
- 2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.**
- 3. Division 26 sections for connections to electrical power system and for low-voltage wiring.**
- 4. Division 28 sections for coordination with other components of electronic access control system.**

1.2 REFERENCES

A. UL - Underwriters Laboratories

- 1. UL 10B - Fire Test of Door Assemblies**
- 2. UL 10C - Positive Pressure Test of Fire Door Assemblies**
- 3. UL 1784 - Air Leakage Tests of Door Assemblies**
- 4. UL 305 - Panic Hardware**

B. DHI - Door and Hardware Institute

- 1. Sequence and Format for the Hardware Schedule**
- 2. Recommended Locations for Builders Hardware**
- 3. Key Systems and Nomenclature**

C. ANSI - American National Standards Institute

- 1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties**

1.3 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

B. Action Submittals:

1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - a. Door Index; include door number, heading number, and Architects hardware set number.
 - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - c. Type, style, function, size, and finish of each hardware item.
 - d. Name and manufacturer of each item.
 - e. Fastenings and other pertinent information.
 - f. Location of each hardware set cross-referenced to indications on Drawings.
 - g. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - h. Mounting locations for hardware.
 - i. Door and frame sizes and materials.
 - j. Name and phone number for local manufacturer's representative for each product.
 - k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components).

Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.

- 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:

- a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
- b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
- c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
- d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
- e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
 - 1) Forward bitting list, key cuts and key system schematic directly to Tri-City Medical Center, by means as directed by Tri-City Medical Center.
- f. Prepare key schedule by or under supervision of supplier, detailing Tri-City Medical Center's final keying instructions for locks.

6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product Certificates for electrified door hardware, signed by manufacturer:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:
 - a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
 - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data : Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representative for each manufacturer.
 - d. Parts list for each product.
 - e. Final approved hardware schedule, edited to reflect conditions as-installed.
 - f. Final keying schedule
 - g. Copies of floor plans with keying nomenclature
 - h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.4 QUALITY ASSURANCE

- A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
 1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
 - a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.
 2. Where products indicate "acceptable manufacturers" or "acceptable manufacturers and products", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.
- B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project.
 1. Warehousing Facilities: In Project's vicinity.
 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.
- D. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
 2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- E. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- F. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
- G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- H. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.
- I. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
 2. Maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.
- J. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Attendees: Tri-City Medical Center, Contractor, Architect, Installer, and Supplier's Architectural Hardware Consultant.
 2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.

- e. Address for delivery of keys.
- K. Pre-installation Conference: Conduct conference at Project site
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Inspect and discuss preparatory work performed by other trades.
 - 3. Inspect and discuss electrical roughing-in for electrified door hardware.
 - 4. Review sequence of operation for each type of electrified door hardware.
 - 5. Review required testing, inspecting, and certifying procedures.
- L. Coordination Conferences:
 - 1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
 - a. Attendees: Door hardware supplier, door hardware installer, Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
 - 2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
 - a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Tri-City Medical Center, Architect and Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 - 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
 - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 - 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
 - 1. Promptly replace products damaged during shipping.
 - 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.

- 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Tri-City Medical Center.
- F. Deliver keys and permanent cores to Tri-City Medical Center as directed.

1.6 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Tri-City Medical Center's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.
- F. Direct shipments not permitted, unless approved by Contractor.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
 - a. Closers:
 - 1) Mechanical: 30 years.
 - b. Automatic Operators: 2 years.
 - c. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - d. Locksets:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - e. Continuous Hinges: Lifetime warranty
 - f. Key Blanks: Lifetime

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Tri-City Medical Center requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

- A. Fasteners
 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.3 HINGES

A. Provide three-knuckle, concealed bearing hinges.

1. Manufacturers and Products:

- a. Scheduled Manufacturer and Product: Ives 3CB series
- b. Acceptable Manufacturers and Products: Hager AB series, McKinney TA series

B. Requirements:

- 1. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
- 2. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
- 3. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
- 4. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
- 5. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
- 6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
- 7. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
- 8. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
- 9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
- 10. Provide mortar guard for each electrified hinge specified.
- 11. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.4 CONTINUOUS HINGES

A. Stainless Steel

1. Manufacturers:
 - a. Scheduled Manufacturer: Ives
 - b. Acceptable Manufacturers: Markar, Stanley
2. Requirements:
 - a. Provide pin and barrel continuous hinges conforming to ANSI/BHMA A156.26, Grade 2.
 - b. Provide pin and barrel continuous hinges fabricated from 14 gauge, type 304 stainless steel.
 - c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
 - d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
 - e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 - f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
 - g. Install hinges with fasteners supplied by manufacturer.
 - h. Provide hinges with symmetrical hole pattern.

2.5 ELECTRIC POWER TRANSFER

- A. Manufacturers:
 - a. Scheduled Manufacturer: Von Duprin
 - b. Acceptable Manufacturers: Falcon, ABH
- B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.
- C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.6 FLUSH BOLTS

- A. Manufacturers:
 1. Scheduled Manufacturer: Ives
 2. Acceptable Manufacturers: Trimco, Rockwood
- B. Requirements:
 1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.7 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Trimco, Rockwood

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

2.8 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Corbin-Russwin ML2000 series
2. Acceptable Manufacturers and Products: No Substitute

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
4. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
5. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
 - a. Lever Design: Corbin-Russwin LWA.

2.9 EXIT DEVICES

A. Manufacturer and Product:

1. Scheduled Manufacturer: Von Duprin 98 series
2. Acceptable Manufacturers and Products: No Substitute.

B. Manufacturers and Products:

1. Scheduled Manufacturer: To establish standard of quality and design intent, exit device specifications have been based on Von Duprin products. Products of other manufacturers meeting or exceeding design and performance requirements specified

herein will be considered for substitution subject to compliance with provisions of Division 01 Section "Product Requirements."

C. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3-2014 Grade 1, UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4,] and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to "KEYING" article, herein.
2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
3. Quiet Operation: Incorporate fluid damper or other device that eliminates noise of exit device operation.
4. Touchpad: Extend minimum of one half of door width, but not the full length of exit device rail. Provide end-cap with two-point attachment to door. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. Provide compression springs in devices, latches, and outside trims or controls; tension springs prohibited.
5. Provide rim devices with a dual cylinder or inside thumb turn cylinder option with a visual security indicator that identifies the trims locked/unlocked status of the door from the inside of the room. Indicator in unlocked state presents a 1/2 inch x 1/2 inch white metal flag with black icon at top of device head. Indicator in locked state has no flag present. Provide rim devices without the dual cylinder or inside thumb turn cylinder option capable of being retrofitted with the visual security indicator.
6. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrical requirements.
7. Provide exit devices with manufacturer's approved strikes.
8. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - a. Lever Style: Match lever style of locksets.
11. Provide UL labeled fire exit hardware for fire rated openings.
12. Provide electrified options as scheduled in the hardware sets.

2.10 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage or Von Duprin PS900 series
2. Acceptable Manufacturers and Products: Precision ELR series, Sargent 3500 series, Dynalock 5000 series, Folger Adam FABPS series, Securitron BPS series, Security Door Controls 600 series

B. Requirements:

1. Provide power supplies, recommended and approved by manufacturer of electrified locking component, for operation of electrified locks, electrified exit devices, magnetic locks, electric strikes, and other components requiring power supply.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply , and UL class 2 listed.
4. Options:
 - a. Provide power supply, where specified, with internal capability of charging sealed backup batteries 24 VDC, in addition to operating DC load.
 - b. Provide sealed batteries for battery back-up at each power supply where specified.
 - c. Provide keyed power supply cabinet.
5. Provide power supply in an enclosure, complete, and requiring 120VAC to fused input.
6. Provide power supply with emergency release terminals, where specified, that allow release of all devices upon activation of fire alarm system complete with fire alarm input for initiating "no delay" exiting mode.

2.11 CYLINDERS MATCH EXISTING KEY SYSTEM OR AS DIRECTED

A. Manufacturers:

1. Scheduled Manufacturer: Corbin-Russwin
2. Acceptable Manufacturers: Unknown

B. Requirements:

1. Provide cylinders/cores, from the same manufacturer of locksets, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Conventional cylinder with **interchangeable core (SFIC)** core with open keyway.
 - b. Keying: Manufacturer-keyed permanent cylinders/cores, configured into keying system per "KEYING" article herein.
 - c. Features: Cylinders/cores shall incorporate the following features.
3. Nickel silver bottom pins.
4. Replaceable Construction Cores.
 - a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 1) 12 construction change (day) keys.
 - b. Tri-City Medical Center or Tri-City Medical Center's Representative will replace temporary construction cores with permanent cores.

2.12 KEYING MATCH EXISTING KEY SYSTEM OR AS DIRECTED

- A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Requirements:
 - 1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - a. Keying system as directed by the Tri-City Medical Center.
 - 2. Forward biting list and keys separately from cylinders, by means as directed by Tri-City Medical Center. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Tri-City Medical Center.
 - 3. Provide keys with the following features.
 - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 4. Identification:
 - a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Blind code marks shall not include actual key cuts.
 - b. Identification stamping provisions must be approved by the Architect and Tri-City Medical Center.
 - c. Stamp cylinders/cores and keys with Tri-City Medical Center's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - d. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Tri-City Medical Center.
 - e. Forward permanent cylinders/cores to Tri-City Medical Center, separately from keys, by means as directed by Tri-City Medical Center.
 - 5. Quantity: Furnish in the following quantities.
 - a. Change (Day) Keys: 3 per cylinder/core.
 - b. Permanent Control Keys: 3.
 - c. Master Keys: 6.
 - d. Unused balance of key blanks shall be furnished to Tri-City Medical Center with the cut keys.
 - e. Extra Keys:
 - 1) 2 Presentation Keys
 - 2) 2 Construction Keys

2.13 DOOR CLOSERS

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product: LCN 4040XP series
 - 2. Acceptable Manufacturers and Products: Sargent 281/281P10/281TJ series factory assembled (without PRV)
- B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter, with 5/8 inch (16 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.14 ELECTRO-MECHANICAL AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN Senior Swing
2. Acceptable Manufacturers and Products: Besam Swingmaster MP, Horton 4000LE series

B. Requirements:

1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI/BHMA A156.19.
 - a. Opening: Powered by DC motor working through reduction gears.
 - b. Closing: Spring force.
 - c. Manual, hydraulic, or chain drive closers: Not permitted.
 - d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
 - e. Cover: Aluminum.
2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.
3. Provide drop plates, brackets, or adapters for arms as required to suit details.
4. Provide hard-wired motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.
5. Provide key switches, with LED's, recommended and approved by manufacturer of automatic operator as required for function as described in operation description of hardware sets. Cylinders: Refer to "KEYING" article, herein.
6. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or

egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.

7. Provide units with inputs for smoke evacuation doors, where specified, which allow doors to power open upon fire alarm activation and hold open indefinitely or until fire alarm is reset, presence detector input, which prevents closed door from opening or door that is fully opened from closing, hold open toggle input, which allows remote activation for indefinite hold open and close second time input is activated, vestibule inputs, which allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.15 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Trimco, Rockwood

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
 - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.16 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Trimco, Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.17 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International
2. Acceptable Manufacturers: National Guard, Pemko

B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.18 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 630 (US32D)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying section.
- I. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Testing and labeling wires with Architect's opening number.
- J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
- L. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
 - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

- P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- Q. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.3 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.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.4 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.5 DEMONSTRATION

- A. Provide training for Tri-City Medical Center's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.6 DOOR HARDWARE SCHEDULE

- A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

Hardware Group 01 - OBSERVATION ROOM DOOR

Door(s):

168

| Qty | | Description | Catalog Number | Finish | Mfr |
|-----|----|-------------------|---------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 715 | 630 | IVE |
| 1 | EA | MULT PT STOREROOM | LM9380F 03A LLL | 630 | SCH |
| 1 | EA | MORT. CYLINDER | BLDG STANDARD | 626 | |
| 1 | EA | MASTER RING | 1060 118 77 KWY | 626 | |
| | | CYLINDER | | | |
| 1 | EA | PUSH PLATE | 8200 6" X 16" | 630 | IVE |
| 1 | EA | ARMOR PLATE | 8400 36" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | EDGE GUARD | 7306B 84" 1.25" 4 EDGE MS | US32D | IVE |
| 1 | EA | GASKETING | 188S-BK | S-Bk | ZER |

Hardware Group 02 - CORRIDOR DOOR

Door(s):

168A

| Qty | | Description | Catalog Number | Finish | Mfr |
|-----|----|-------------------------|---------------------------|--------|-----|
| 1 | EA | CONT. HINGE | 715 | 630 | IVE |
| 1 | EA | CLASSROOM LOCK | ML2055 LWA | 630 | C-R |
| 1 | EA | MORT. CYLINDER | BLDG STANDARD | 626 | |
| 1 | EA | MASTER RING | 1060 118 77 KWY | 626 | |
| | | CYLINDER | | | |
| 1 | EA | SURFACE CLOSER | 4040XP EDA MC | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | EDGE GUARD | 7306B 84" 1.25" 4 EDGE MS | US32D | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| | | [REQUIRES WALL BACKING] | | | |
| 1 | EA | GASKETING | 188S-BK | S-Bk | ZER |

Hardware Group 03 - DOUBLE ACTING TOILET ROOM DOOR

Door(s):

168B

| Qty | | Description | Catalog Number | Finish | Mfr |
|-----|----|--------------------------|--|--------|-----|
| 1 | EA | PIVOT SET | 7255 SET | 626 | IVE |
| 1 | EA | INSTITUTION PRIV LOCK | ML2069 LWA LC | 630 | C-R |
| 1 | EA | MORT. CYLINDER | BLDG STANDARD | 626 | |
| 1 | EA | MASTER RING CYLINDER | 1060 118 77 KWY | 626 | |
| 1 | EA | DOUBLE LIPPED STRIKE | 452 6-3/4 | 26D | HAG |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| | | PLEASE NOTE | [REQUIRES WALL BACKING] REQUIRED SIGNAGE SPECIFIED IN SECTION 10 14 00 | UNK | UNK |

End of Section

SECTION 08 84 00

PLASTIC GLAZING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Polycarbonate glazing for:
 - a. Hollow Metal Doors and Frames: Section 08 11 13.
 - b. Installation over existing aluminum-framed window.
 - 2. Glazing 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. American National Standards Institute (ANSI) Standards; www.ansi.org.
 - a. ANSI Z97.1-2015 – Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Submit for all glazing products supplied under this Section.
- C. Shop Drawings:
 - 1. Submit layout drawings of plastic glazing assemblies.
 - 2. Submit drawings of plastic glass panels with vent holes.
- D. Samples:
 - 1. Submit samples of each type of plastic glazing material to be supplied.
 - a. Cut sizes as requested by Architect.
 - 2. Submit samples of vandal-proof anchors.

1.04 INFORMATIONAL SUBMITTALS

- A. Procedures: Submit for information and verification in accordance with Section 01 33 00.
- B. Certificates:
 - 1. Submit certification that polycarbonate sheet is listed by UL as a Burglary-Resisting Glazing Materials under Standard UL 972.
 - 2. Submit certification that polycarbonate sheet complies with 16 CFR 1201 Safety Standard for Architectural Glazing Materials for Category I and Category II applications.
- C. Test and Evaluation Reports:
 - 1. Test Reports: Upon request, submit certified laboratory test reports confirming physical characteristics of materials used in the performance of the work of this Section.

- D. Manufacturer's Instructions:
 - 1. Submit Manufacturer's cleaning and maintenance instructions.
 - a. Maintain one additional copy on site until completion of Project.

1.05 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Section 01 77 00:
 - 1. Operating and Maintenance Data: Polycarbonate sheet manufacturer's cleaning and maintenance instructions.
 - 2. Warranty.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. General Requirements: Comply with Section 01 60 00 and with Manufacturer's recommendations.
- B. Storage and Handling Requirements:
 - 1. Storage: Store cases according to printed instructions on case, in areas least subject to traffic or falling objects. Keep storage area clean and dry.
 - 2. Handling: Unpack cases following printed instructions on case. Stack individual sheets on edge leaned slightly against upright supports with separators between each.

1.07 WARRANTY

- A. Provide polycarbonate sheet manufacturer's ten-year warranty against yellowing, abrasion, breakage, loss of light transmission, and coating failure.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design Manufacturer and Polycarbonate Product: GE Structured Products – LEXAN MR10 Sheet with Margard II Coating.
- B. 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 POLYCARBONATE SHEET

- A. Description: Clear polycarbonate resin sheet with abrasion resistant, UV resistant coating.
- B. Thickness: 1/4-inch nominal.
- C. Regulatory Requirements: Classified CC1 under IBC Section 2606.4.

2.03 FABRICATION

- A. Provide factory cut panels in required dimensions, with clean cuts without chips or other deformities; without debris, grease, oil, or other materials lodged inside cells.
- B. Vent Holes: Factory drilled at locations indicated on Drawings.

- C. Fabrication Tolerances:
 - 1. Dimensions and Squareness: Plus-or-minus 1/16-inch.

2.04 ACCESSORIES

- A. Setting Blocks, Shims and Glazing Clips: Size and type as recommended by plastic sheet manufacturer.
- B. Glazing Gaskets: EPDM or Neoprene rubber.
- C. Fasteners: Vandal-proof type, with tamper-proof heads and non-corrosive coating compatible with materials being joined.
 - 1. Acceptable Manufacturers and Products:
 - a. Bryce Fastener; www.brycefastener.com.
 - b. Tamperproof Screw Company; www.tamperproof.com - Torx Fastener.

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. Existing Conditions:
 - a. Field Measurements: Field measure openings before fabricating plastic sheet products. Be responsible for proper fit of field measured products.
 - b. Before glazing, verify that frames are plumb and square with stops set for proper sheet-to-stop face clearance.
- 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. Examine panels for damage prior to installation.
- B. Clean surfaces thoroughly prior to installation.

3.03 GLAZING

- A. Glazing in Window Frames and Doors: Install plastic sheet on setting blocks as recommended by the polycarbonate sheet manufacturer. Dry glaze using glazing gaskets providing resilient clamping grip on polycarbonate panels.
- B. Installing Polycarbonate Over Existing Aluminum Frame: Cover existing glass and frame and fasten polycarbonate sheet with vandal-proof anchors as indicated on Drawings.

3.04 ADJUSTING

- A. Upon completion, installation shall be free of scratches and rattles.
- B. Breakage: Unless responsibility can be assessed to another contractor, be responsible for glass broken during shipment, storage and installation.

3.05 CLEANING

- A. Clean polycarbonate in accordance with manufacturer's written instructions.

3.06 PROTECTION

- A. Completely cover during spray painting, texturing or other construction operations that might cause damage to glazing.

END OF SECTION

DIVISION 09 – FINISHES

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 leveling.
3. Concrete slab cleaning.
4. Vapor emission control treatment, if required.

B. Related Requirements:

1. Quality Control and Testing: Section 01 45 20 Quality Control.

1.02 PRICE AND PAYMENT PROCEDURES

- ###### A. Unit Price for Vapor Emission Control Treatment: Section 01 22 00 Unit Prices.

1.03 REFERENCES

A. Reference Standards: Comply with following except as modified by supplementary requirements of this Project Specification.

1. American National Standards Institute (ANSI) Standards:
 - a. ANSI A108 - American National Standard Specifications for Installation of Ceramic Tile:
 - 1) A108.01 – General Requirements: Subsurfaces and Preparations by Other Trades – 2013 (Revised).
2. ASTM International Standard Specifications and Test Methods:
 - a. ASTM F1869-11 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - b. ASTM F2170-11 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

- 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 F710-11 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - b. ASTM F2678-10 – 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.

1.04 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.

1.05 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Submit for following products for approval by Architect only if products are required to be utilized based on testing results:
 - 1. Vapor Emission Control Treatment: Include data documenting compliance with product performance requirements specified in this section.

1.06 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.

1.07 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.

1.08 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Vapor Emission Control Treatment Installer: Vapor Emission Control Treatment Manufacturer employed or certified personnel.

1.09 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.

1.10 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 36, 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. – MC Moisture Control System.
 - a. Primer: Ardex P-MC.
 - b. Sealer: Ardex S-MC.
 - 2. Floor Seal Technology, Inc.; 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. - 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 - Synthetic30, utilizing the following materials:
 - a. Non-porous primer
 - b. Synthetic30 penetrating waterborne polymer.
 - 5. Substitution Requests: Required for all manufacturers and products not named as Acceptable Manufacturer and System.
 - a. Submit in accordance with Section 01 25 00.

- 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 ft² 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. System Unit Price: Material, delivery, and installation cost of cementitious underlayment shall be included in unit price of vapor emission control treatment system reported in accordance with Section 01 22 00.

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.foundationarmor.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.

PART 3 EXECUTION

3.01 TESTING, GENERAL

- A. Contractor's Quality Control: The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers. Contractor shall strictly follow concrete floor slab specifications, and shall take all other reasonable measures necessary to ensure that moisture is controlled and floor slabs are properly prepared to receive specified finish flooring systems.
 - 1. Inspection or testing by the Owner does not relieve Contractor of his responsibility to perform the Work in accordance with the Contract Documents.
- B. Testing Agency: Vapor emission and alkalinity testing will be conducted by an approved testing agency in accordance with ASTM F710 and Section 01 45 20.
 - 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 20. 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.
- C. 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. Wood Flooring, Fluid-Applied Flooring, and Floor Coatings: Vapor emission tests will be considered satisfactory if measured moisture emission does not exceed 3 pounds per 1000 square feet over 24 hours.
 - c. 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.
 - d. 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 3 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: 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 additional drying time, or, at Owner's option, may be required to 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 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.
 - 3. Surface Profile: Verify surface to be smooth troweled finish.
- 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:
 - 1. Floor Slabs-on-Grade: All floor slabs-on-grade shall receive specified vapor emission control treatment unless testing demonstrates to Owner's satisfaction that treatment may be waived.
 - 2. Structural Concrete Floor Slabs: 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.
 2. Fibrous Reinforced Slabs: Burn off or scrape away and vacuum after shot blasting, leaving no fibers on concrete surfaces.
- 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 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. 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. Protect freshly placed slabs from weather damage.
- C. Protect slabs from mortar leakage from placing of slabs above.
- D. 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. Promptly remove snow and standing water from floor slabs.
 - 2. Do not wash construction tools or materials over floor slabs.
- E. Do not permit construction activities such as pipe cutting which could damage or stain floor slabs.
- F. 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 SUMMARY

- A. Work Results:
 - 1. New metal stud and gypsum board partitions.
 - 2. Suspended gypsum board ceiling and soffit assemblies.
 - 3. Gypsum board ceilings and coves on metal ceiling joist framing.
 - 4. Gypsum board and metal stud wall opening infill.
 - 5. Patching existing gypsum board walls and ceilings.
- B. Products Installed But Not Supplied Under This Section:
 - 1. Access Doors and Panels: Section 08 31 00.
 - 2. Acoustical Blanket Insulation: Section 09 81 16.
- C. 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. Fire Safing Material for Deflection Channels: Section 07 84 00 Firestopping.
 - 3. Acoustical Sealants: Section 07 92 00 Joint Sealants.
 - 4. Painting: Section 09 91 23 Interior Painting.

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. 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.
- C. Reference Standards: Comply with the following except as otherwise specified in this Project Manual.
 - 1. ANSI/AISI Standards:
 - a. AISI S200-12 – North American Standard for Cold-Formed Steel Framing – General Provisions, 2012 Edition.
 - b. AISI S201-12 – North American Standard for Cold-Formed Steel Framing – Product Data, 2012 Edition.
 - c. AISI S212-07 (2012) – North American Standard for Cold-Formed Steel Framing – Header Design, 2007 Edition (Reaffirmed 2012).
 - d. AISI S220-15 – North American Standard for Cold-Formed Steel Framing – Nonstructural Members, 2015 Edition.
 - 2. ASTM International Standards: www.astm.org.
 - a. ASTM C645-14e1 – Standard Specification for Nonstructural Steel Framing Members.
 - b. ASTM C754-15 – Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - c. ASTM C840-16 - Standard Specification for Application and Finishing of Gypsum Board.
 - d. ASTM C1396 / C1396M-14a – Standard Specification for Gypsum Board.

3. Gypsum Association Standards: www.gypsum.org.
 - a. GA-216-2016 – Application and Finishing of Gypsum Panel Products.
 - b. Fire Rated Construction: GA-600-2015 –Fire Resistance Design Manual.
 4. UL Standards: www.ul.com.
 - a. UL Online Certifications Directory: Reference.database.ul.com.
- D. Guide References and Standard Practices: Follow recommendations of the following:
1. Gypsum Association Publications: www.gypsum.org.
 - a. GA-214-2015 – Recommended Levels of Finish for Gypsum Board, Glass Mat and Fiber-Reinforced Gypsum Panels.

1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Submit copies of manufacturer's technical data covering all assembly materials with all options and accessories plainly identified.
1. Submit product data sheets for each type of metal furring channel to be provided.
 2. Submit product data sheets for all non-structural metal framing components and accessories to be provided.
 - a. 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.

1.04 QUALITY ASSURANCE

- A. Mockups:
1. Build mockups of at least 100 square feet in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution for the following:
 - a. Each Level 3, 4, and/or 5 gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 2. Use construction methods and materials specified.
 3. Prepare mockups to illustrate both pre-decorated and decorated gypsum board finishing for approval.
 - a. If directed by Architect, apply or install final decoration indicated, including painting and wallcoverings, over a portion of exposed mockup surfaces, to allow review of mockups for both pre-decorated and decorated conditions in single review.
 - b. If directed by Architect, obtain approval of pre-decorated gypsum board finish prior to application of final decoration for approval.
 4. Simulate finished lighting conditions for review of mockups.
 5. For mockups illustrating gypsum board finishing to receive paint, afford opportunity to painting contractor to review and accept gypsum board finishing methods prior to start of painting operations.
 6. Accepted Sample Areas: Standard for rest of work. Proceed with work only after sample has been reviewed and approved by Architect.
 7. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 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 in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.
- C. Storage and Handling Requirements:
 - 1. Storage: Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes.
 - a. Neatly stack gypsum boards flat to prevent sagging.
 - b. Store metals above ground on platforms, skids, or other supports. Protect metals from surface contamination and corrosion.
 - 2. Handling: Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.06 AMBIENT CONDITIONS

- A. Comply with ASTM C840 and Manufacturer's recommendations.
- B. During gypsum panel application and finishing, maintain temperatures within building within range of 55 degrees to 70 degrees F.
- C. Provide adequate ventilation to carry off excess moisture.

PART 2 PRODUCTS

2.01 ASSEMBLIES

- A. Partitions: See Drawings for detailed assembly requirements.
 - 1. 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.
 - a. Water Resistant Type: Use at toilet rooms and elsewhere as indicated.
 - b. Impact Resistant Type: Provide at following locations and as noted on Drawings:
 - 1) Seclusion room and toilet room walls where wall padding is not indicated.
- B. Ceilings and Interior Soffits:
 - 1. Gypsum Board Panels: Provide panels 5/8-inch thick unless specifically indicated otherwise, by 48 inches wide by length to minimize cross joints.
 - 2. Seismic Suspension System Bracing: Ceiling system and connections shall be designed and constructed in accordance with requirements of ICC Evaluation Service Report for ceiling suspension systems in Seismic Design Category adopted by local code. See Drawings for related requirements.
- C. Fire Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
 - 1. Gypsum Board Partitions: Partitions listed and labeled for fire protective ratings where indicated.
 - 2. 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. See Drawings and Sections 01 42 00. Products shall be one of those listed in referenced UL assembly.
 - 3. All gypsum board ceilings that are part of a rated roof/ceiling assembly shall comply with all requirements of that assembly.
 - 4. Gypsum board ceilings and soffits that are suspended below rated assemblies are unrated.

2.02 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.

2.03 GYPSUM BOARD AND JOINT FINISHING MATERIALS

- A. General:
1. Reference Standard: Each type of gypsum board shall be as defined by, and shall comply with requirements of, ASTM C1396/C1396M.
 2. Single Source Responsibility: Obtain each type of gypsum board and related joint treatment materials from a single manufacturer.
 3. All gypsum board and gypsum board finishing materials shall be formaldehyde-free and asbestos-free.
- B. Type X Gypsum Board: For all locations not specified otherwise.
1. Acceptable Manufacturers and Products:
 - a. American Gypsum; www.americangypsum.com - American Gypsum Firebloc Type X.
 - b. CertainTeed Corporation; www.certainteed.com - CertainTeed Type X Gypsum Board.
 - c. Georgia-Pacific Gypsum LLC; www.gp.com - ToughRock Fireguard X Gypsum Board.
 - d. National Gypsum Company; www.nationalgypsum.com. - Gold Bond Fire-Shield Gypsum Board.
 - e. Pabco Gypsum; www.pabco gypsum.com - Pabco Flame Curb Type X Gypsum Board.
 - f. United States Gypsum Company (USG); www.usg.com - Sheetrock Brand Firecode X Gypsum Panels.
 2. Core: Type X.
 3. Surfaces: Paper.
 4. Thickness: 5/8-inch.
 5. Edge: Tapered.
 6. UL Classified as to fire resistance, surface-burning characteristics and noncombustibility.
- C. Type X Moisture-Resistant, Mold-Resistant Gypsum Board: For high humidity applications.
1. Acceptable Manufacturers and Products:
 - a. American Gypsum; www.americangypsum.com - American Gypsum M-Bloc Type X Gypsum Board.
 - b. CertainTeed Corporation; www.certainteed.com - CertainTeed M2Tech Type X Gypsum Board.
 - c. Georgia-Pacific Gypsum LLC; www.gp.com - ToughRock Fireguard X Mold-Guard Gypsum Board.
 - d. National Gypsum Company; www.nationalgypsum.com. - Gold Bond XP Fire-Shield Gypsum Board.
 - e. Pabco Gypsum; www.pabco gypsum.com - Pabco Water Curb Type X Gypsum Board.
 - f. United States Gypsum Company (USG); www.usg.com - Sheetrock Brand Mold Tough Firecode Gypsum Panels.
 2. Core: Type X, moisture-resistant.
 3. Surfaces: Moisture resistant and mold-resistant paper on front, back, and long edges.
 4. Thickness: 5/8-inch.
 5. Edge: Tapered.
 6. Mold Resistance: ASTM D3273, score of 10, and ASTM G21, score of 0.
 7. Moisture Resistance: ASTM C473, less than 5 percent water absorption.
 8. UL Classified as to fire resistance, surface-burning characteristics and noncombustibility.

- D. Type C Gypsum Board: For fire rated construction and all locations not specified otherwise.
1. Acceptable Manufacturers and Products:
 - a. American Gypsum; www.americangypsum.com - American Gypsum Firebloc Type C Gypsum Board.
 - b. CertainTeed Corporation; www.certainteed.com – CertainTeed Type C Gypsum Board.
 - c. Georgia-Pacific Gypsum LLC; www.gp.com – ToughRock Fireguard C Gypsum Board.
 - d. National Gypsum Company; www.nationalgypsum.com. - Gold Bond Fire-Shield C Gypsum Board.
 - e. Pabco Gypsum; www.pabco gypsum.com – Pabco Flame Curb Type C Gypsum Board.
 - f. United States Gypsum Company (USG); www.usg.com – Sheetrock Brand Firecode C Gypsum Panels.
 2. Core: Type C or Type X.
 3. Surfaces: Paper.
 4. Thickness: 5/8-inch.
 5. Edge: Tapered.
 6. UL Classified as to fire resistance, surface-burning characteristics and noncombustibility.
- E. Impact Resistant Gypsum Board:
1. Acceptable Manufacturers and Products:
 - a. American Gypsum; www.americangypsum.com - American Gypsum M-Bloc IR Type X Gypsum Board.
 - b. CertainTeed Corporation; www.certainteed.com – AirRenew Extreme Impact Impact Resistant Gypsum Board.
 - c. National Gypsum Company; www.nationalgypsum.com. - National Gypsum Hi-Impact XP Gypsum Board.
 - d. Pabco Gypsum; www.pabco gypsum.com – Pabco High Impact.
 2. Core: Type X, fiberglass reinforced.
 3. Surfaces: Heavy abrasion-resistant paper.
 4. Thickness: 5/8-inch.
 5. Edge: Tapered.
 6. Abrasion Resistance: ASTM C1629, minimum Level 2.
 7. Indentation Resistance: ASTM C1629, minimum Level 1.
 8. Soft Body Impact Resistance: ASTM C1629, Level 3.
 9. Hard Body Impact Resistance: ASTM C1629, Level 3.
 10. UL Classified as to fire resistance, surface-burning characteristics and noncombustibility.
- F. Joint Finishing Materials: As recommended by gypsum board manufacturer for use with applicable gypsum board product.
1. Joint Tape: Cross-fibered reinforced paper or fiberglass mesh as recommended by manufacturer for use with applicable gypsum board product.
 2. Joint Compound for Use With Paper Tape: All-purpose type specifically formulated and manufactured for use with embedding tape at gypsum board joints and as a finishing compound, and compatible with tape, substrate and fasteners.
 3. Joint Compound for Use With Fiberglass Tape: Setting type specifically formulated and manufactured for use with fiberglass tape at gypsum board joints, and compatible with tape, substrate and fasteners.
 4. Topping Compound: Topping type specifically formulated and manufactured for use for smooth joint finishing in second and third coats. Unthinned

2.04 NON-LOAD-BEARING METAL PARTITION STUDS AND RUNNERS

- A. Basis of Design Non-Load-Bearing Metal Partition Stud Manufacturer: California Expanded Metal Products Company (CEMCO); www.cemcosteel.com.

- B. Other Acceptable Non-Load-Bearing Metal Partition Stud Manufacturers:
 - 1. ClarkDietrich Building Systems LLC, www.clarkdietrich.com.
 - 2. MarinoWARE; www.marinoware.com.
 - 3. Studco Building Systems; www.studcosystems.com.
- C. Stud Sizes: As indicated on Drawings.
- D. Steel Stud Gages: As indicated on Drawings.
 - 1. Verify gages required for support of wall-hung equipment with equipment manufacturer's recommendations.
- E. Steel Stud Runners: Manufacturer's standard to match studs. Provide long leg runners for slip joint at structure above where indicated.
- F. Finish for Studs, Runners, Bracing and Accessories: Corrosion resistant galvanized coating conforming to ASTM A653, G40 minimum.

2.05 CEILING AND SOFFIT FRAMING

- A. Non-Accessible Ceiling and Soffit Framing: 16 gauge studs, sizes as indicated, 16 inches on center unless otherwise indicated on Drawings.
 - 1. Spans Greater Than 8 Feet: Joist framing to comply with Section 05 40 00.
- B. Accessible Ceiling and Soffit Framing: Joist framing to comply with Section 05 40 00.

2.06 CEILING SUSPENSION SYSTEMS

- A. Acceptable Manufacturers:
 - 1. Armstrong; www.armstrong.com.
 - 2. Chicago Metallic; www.chicagometallic.com.
 - 3. United States Gypsum Company (USG); www.usg.com.
- B. 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.
- C. Suspended Framing System Description: 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. See Drawings for related requirements.
 - 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.

2.07 ACOUSTIC INSULATION AND SEALANTS

- A. Sound Attenuation Blankets: See Section 09 81 16.
- B. Acoustical Sealant: See Section 07 92 00.

2.08 FINISHES

- A. Skim Coat Finish: Unthinned topping joint compound formulated for filling, leveling and finishing coats.

2.09 ACCESSORIES

- A. Fasteners: ASTM C1002.
 - 1. Fastening to Metal: One-inch Type S gypsum board screws. Use proper type for gage of stud.
- B. Laminating Adhesive: Setting type compound, formaldehyde-free and asbestos-free, and as recommended by gypsum board manufacturer for use with applicable gypsum board product.
- C. Cornerbead and Edge Trim for Interior Installation: Provide corner beads, edge trim and control joints that comply with ASTM C1047 and requirements indicated below:
 - 1. Acceptable Manufacturers:
 - a. California Expanded Metal Products Company (CEMCO); www.cemcosteel.com.
 - b. ClarkDietrich Building Systems LLC, www.clarkdietrich.com.
 - c. Phillips Manufacturing Company; www.phillipsmfg.com.
 - d. United States Gypsum Company (USG); www.usg.com - Beadex.
 - 2. Material: Formed metal, or metal combined with paper:
 - 3. Edge Trim: USG Sheetrock No. 103 Dur-A-Bead, 1-1/4-inch by 1-1/4-inch, unless otherwise indicated.
 - 4. One-Piece Control Joint: Formed with vee-shaped slot per Fig. 1 in ASTM C1047, with slot opening covered with removable strip.

PART 3 EXECUTION

3.01 ERECTION OF NON-LOAD-BEARING METAL STUD PARTITIONS

- A. Reference Standard: Erect steel framing in accordance with ASTM C754.
- B. Layouts: Align partition studs accurately according to partition layout.
- C. Anchoring: Anchor runner channels to concrete slabs with concrete stud nails or power-driven anchors at 24 inches on center. Anchor runner channels to ceiling grid where applicable with stove bolts. Install headers where required to receive runners where studs extend above ceiling system.
- D. Studs: Position studs vertically in runners. Anchor studs located adjacent to openings or partition intersections and corners to runners with USG metal lock fastener or with 1/2-inch Type S pan head screws.
 - 1. Space studs 16 inches on center unless otherwise indicated, and not less than that required by referenced steel framing installation standard.
 - 2. Corners and Intersections: Locate studs no more than two inches from abutting partitions, corners, etc.
 - 3. Openings: Frame door openings to comply with details indicated, with GA-219 and with applicable published recommendations of gypsum board manufacturer. Locate studs not more than two inches from opening frames. Anchor studs to frame anchor clips by bolt or screw attachment. Install runner track section (for cripple studs) at head and secure to jamb studs. Install headers over openings as recommended by the manufacturer.
 - a. Wood Doors and Hollow Metal Doors: Provide two studs at jambs.
 - 4. Metal Strap Blocking: See Drawings.

5. Install runners (tracks) at floors, ceilings and structural walls and columns where gypsum board stud system abuts other construction.
 - a. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.
 6. Installation Tolerances: Install each steel framing and furring member so that fastening surface do not vary more than 1/8 inch from plane of faces of adjacent framing.
 7. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 8. Terminate partition framing at suspended ceilings where indicated.
 9. Install steel studs so that flanges point in the same direction and gypsum boards can be installed in the direction opposite to that of the flange.
 10. Position studs vertically with open sides facing in same direction and engaging floor and ceiling runners. Begin and end each arc with a stud and space intermediate studs equally along arcs at stud spacing recommended by gypsum board manufacturer for radii indicated.
 11. Attach studs to runners with 3/8-inch long pan head framing screws. On straight lengths at ends of arcs, place studs 6 inches on center with last stud left free standing.
- E. Bracing: Provide diagonal bracing at head of studs that terminate above the ceiling level. Bracing shall consist of metal studs bent to V-shape and extending at 45 degrees from partition head to structure above. Locate bracing 48 inches maximum on center
- F. Top of Partition Deflection Head Assemblies:
1. Provide long leg runners for slip joint at structure above for partitions where indicated.
 2. Fire Rated Partitions:
 - a. Firestopping Installation: Under Section 07 84 00.

3.02 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: As indicated.
 - 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-foot 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.

3.03 SOUND TREATMENT

- A. General:
 - 1. Comply with manufacturer's instructions for particular conditions of installation in each case.
 - 2. Install materials to comply with thermal and sound control requirements noted on Drawings.
 - 3. Unfaced Insulation: Not allowed in exposed applications where there is a potential for skin contact and irritation.
- B. Acoustical Blanket Installation in Partitions:
 - 1. Batts: Friction-fit in place until interior gypsum wallboard 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.
 - a. Stud Cavity Heights Up To 8 Feet: Cut lengths to friction-fit against floor and ceiling tracks or plates.
 - b. Stud Cavity Heights Greater Than 8 Feet: Provide supplemental support as required to hold batts in place until the interior finish is applied.
 - 2. Ductwork Penetrations: Provide one inch wide clearance around ductwork and pack with fiberglass ready for caulking.
- C. Acoustical Blanket Installation Over Ceilings: See Section 09 81 16.
- D. Acoustical Sealant: See Section 07 92 00. Apply at perimeter and at all penetrations of gypsum board in single bead.
 - 1. Locations: Apply at partitions with sound attenuation blankets.
 - 2. Caulk ductwork penetrations.
 - 3. Caulk both sides of partitions edges with continuous bead.

3.04 INSTALLATION OF GYPSUM BOARD, GENERAL

- A. Reference Standards: Apply and finish gypsum board in accordance with GA-216 and ASTM C840.
- B. Fastening: Apply board to studs, furring or framing with gypsum board screws spaced 12 inches on center in field of board and eight inches on center staggered along vertical abutting edges.
 - 1. Use Type S-12 screws for attaching to structural studs.
- C. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16-inch open space between boards. Do not force into place.

- D. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field-cut ends. Do not place tapered edges against cut edges or ends.
- E. Trim: Apply as recommended by manufacturer, where gypsum board abuts other materials, and as indicated.
- F. Tolerances: Gypsum board surface plane within plus-or-minus 1/8-inch in 10 feet.

3.05 INSTALLATION OF GYPSUM BOARD ON PARTITIONS AND WALLS

- A. Layout: Apply gypsum wallboard panels vertically with abutting ends and edges occurring over stud flanges or furring. Horizontal installation is not allowed.
 - 1. Joints on Opposite Sides of Partitions: Shall not occur over same stud.
 - 2. Two Layer Construction: Stagger joints between layers.
 - 3. Locate exposed end-butt joints as far from center of walls as possible, and stagger not less than 24 inches in alternate courses of board.
 - 4. Install wall/partition boards in manner that minimizes the number of end-butt joints or avoids them entirely where possible.
 - 5. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back-blocking is provided behind end joints.
- B. Stagger vertical joints over different studs on opposite sides of partitions.
- C. Attach gypsum board to steel studs so that leading edge or end of each board is attached to open (unsupported) edge of stud flange first.
- D. Spot grout hollow metal door frames for solid core wood doors, hollow metal doors and doors over 32 inches wide. Apply spot grout at each jamb anchor clip just before inserting board into frame.
- E. Form control joints and expansion joints at locations indicated, with space between edges of boards, prepared to receive trim accessories.
- F. Cover both faces of steel stud partition framing with gypsum board in concealed spaces (above ceilings, etc.), except in chase walls that are braced internally.
- G. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments. Provide 1/4-inch to 1/2-inch space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant.
- H. Layers: Install multiple layer gypsum board as indicated.
- I. Impact Resistant Boards: Install at locations indicated as recommended by manufacturer for full height above finish floor.
- J. Corner Bead: Apply as recommended by manufacturer at exposed out corners.

3.06 INSTALLATION OF GYPSUM DRYWALL CEILINGS

- A. Install to ceiling framing, to suspended grid framing, or directly to structural framing as indicated.
- B. Apply gypsum board of maximum practical length with long dimensions at right angles to furring channels and fasten with drywall screws spaced 12 inches on center in the field of the board and 8 inches on center along abutting edges. All end and edge joints shall occur over furring

channels with end joints staggered. Properly support gypsum board around cutouts and openings.

3.07 FINISHING

- A. General: Finish gypsum board in accordance with ASTM C840. Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Joint Finishing: Apply joint treatment at side and end joints, corner bead, trim, penetrations and fastener dimples as recommended by manufacturer.
 - 1. Finish panels to following finish levels as defined by ASTM C840 and as recommended by GA-214 where not otherwise specified.
 - a. Level 0: Limited to temporary construction. No taping, finishing or accessories required.
 - b. Level 1: Limited to ceiling plenums and similar concealed areas. Apply tape embedded in joint compound to all joints and interior angles. Excess joint compound, tool marks and ridges are acceptable.
 - c. Level 2: Minimum finish level for gypsum board to receive interior adhered masonry veneer, or bonded acoustical ceiling tile. All joints and interior angles shall have tape embedded in joint compound and wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Cover all fastener heads and accessories with one coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
 - d. Level 3: Minimum finish level for gypsum board to receive ceramic, stone, or glass tile, FRP or other protective wall covering, fixed acoustical panels, or heavy- or medium-texture finishes before final painting. All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Cover fastener heads and accessories with two separate coats of joint compound as required by ANSI A108.01-2013 for gypsum board to receive tile. The surface shall be smooth and free of tool marks and ridges.
 - e. Level 4: Minimum finish level for gypsum board to receive light texture, wallcoverings, and for all gypsum board that will be exposed to view but not specified to receive Level 5 finishing. All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Apply two separate coats of joint compound over all flat joints and one separate coat over interior angles. Cover fastener heads and accessories with three separate coats of joint compound. The surface shall be smooth and free of tool marks and ridges.
 - f. Level 5:
 - 1) Finish gypsum board to Level 5 where so noted on the Drawings and for following applications:
 - a) Gypsum board to receive semigloss or gloss paint or other glossy decorative finish.
 - b) Gypsum board to receive dark or deep tone paint application.
 - 2) Finish joints as specified for Level 4.
 - 3) Apply a skim coat over the entire exposed surface.
 - 2. Prefill open joints and rounded or beveled edges, if any, using setting-type joint compound.
 - 3. Apply joint tape at joints between gypsum boards except at trim accessories.
 - 4. Joint Compound: Sand smooth between coats and after last coat.
 - a. Embedding and first coat: Setting-type joint compound.
 - b. Fill coat: Setting-type joint compound.
 - c. Finish coat: Ready-mix drying-type all-purpose or topping compound.

- C. Skim Coat Application. Skim coat to be troweled on to straight plumb finish prior to final wall painting application or other finish as shown on Drawings.
 - 1. Required for Level 5 finishing.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Work Results:
 - 1. New acoustical grid and suspension system for CBC seismic Category D.
 - 2. New lay-in panels to match existing.
 - 3. Reinstall salvaged ceiling tiles and grid to match existing.
- 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. 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 D. Systems shall be designed and installed in accordance with ASTM C635, ASTM C636, and ASTM E580, Section 4 – Seismic Design Category D.
 - 1. Systems with a current ICC-ES report recognizing the system as a code-compliant alternative method for installation in Seismic Design Category D 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 803.9.
 - 2. System fire rating not required.

2.04 ACOUSTICAL LAY-IN CEILING PANELS

- A. Acoustical Lay-In Panels: See Finish Legend on Drawings.

2.05 SUSPENSION SYSTEMS

- A. Ceiling Suspension System: Intermediate Duty.
 - 1. Exposed Grid Face: Match existing.
 - 2. Color: 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. Suspend grid with hanger wires from structure above. Install hanger wires at 4 feet on center along each main runner, at all four corners of lay-in light fixtures and as required to provide maximum deflection of 1/360 of span and level within 1/8-inch in 12 feet.
 - a. 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

SECTION 09 65 16

RESILIENT SHEET FLOORING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sheet vinyl flooring with integral cove base.
 - 2. New integral sheet vinyl cove base to match existing.
 - 3. Patching sheet vinyl flooring and 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 F1869-16 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - b. ASTM F1303-04(2014) - Standard Specification for Sheet Vinyl Floor Covering with Backing.
 - c. ASTM F1913-04(2014) - Standard Specification for Vinyl Sheet Floor Covering Without Backing.
 - d. ASTM F2170-16a - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
 - 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 F710-11 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

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 gulley 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.
- 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/ cm², Pass - Class 1.
- C. N.B.S. Smoke Chamber Test (ASTM-E-662): Less than 450 – Pass.
- D. Fire Resistance:
 - 1. Flame Spread: Do not exceed flame spread classifications in CBC Table 803.9.

2.03 SHEET VINYL FLOORING (SV) MATERIALS

- A. Homogenous Sheet Vinyl Flooring Without Backing: ASTM F1913.
 - 1. Gauge:
 - a. Overall Nominal Thickness: 0.080 inch (2.03mm).
 - b. Wearlayer Nominal Inlaid Thickness: 0.080 inch (2.03mm).
 - 2. Color: See Finish Legend on Drawings.
- B. Heterogeneous Sheet Vinyl Flooring With Backing: ASTM F1303, Type 1, Grade 1, Class B.
 - 1. Layers: Sheet flooring shall be constructed of four distinct, solid layers, consisting of a wear layer, pattern layer, interconstruction layer, and backing layer.
 - 2. Gauge:
 - a. Overall Nominal Thickness: 0.080 inch (2.03mm).
 - b. Wearlayer Nominal Inlaid Thickness: 0.020 inch (0.51mm).
- C. Heterogeneous Light Sheet Vinyl Flooring With Backing: ASTM F1303, Type 1, Grade 1, Class A.
 - 1. Gauge:
 - a. Overall Nominal Thickness: 0.080 inch (2.03mm).
 - b. Wearlayer Nominal Inlaid Thickness: 0.020 inch (0.51mm).
 - 2. Color: See Finish Legend 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. Metal Trim: Omit.
- 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 03 32 00. 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 03 32 00. 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.
 - 2. Knauf Fiber Glass; 800/825-4434; www.knaufinsulation.us.
 - 3. Owens-Corning, 800/GET-PINK; 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.
 - 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 tiles 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. Primer for Metal Fabrications: Section 05 50 00 Metal Fabrications.
 - 2. 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.
 - 2. Coat: An application of paint or coating that is allowed to dry prior to subsequent application.
 - 3. Sheen Terms:
 - a. Flat: Lusterless or matte finish with a gloss range below 15 when measured at an 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.
- 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.
 - b. Dunn-Edwards Corporation; www.dunnedwards.com.
 - c. Frazee Paint, division of the Comex Group; www.frazeepaint.com.
 - d. Glidden Professional Brand of PPG Architectural Coatings; www.gliddenprofessional.com.
 - e. Kelly-Moore Paint Company; www.kellymoore.com.
 - f. PPG Pittsburgh Paints; www.ppgpittsburghpaints.com.
 - g. Pratt & Lambert, Inc.; www.prattandlambert.com.
 - B. 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 Doors and 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 | Epoxy, Semi-gloss |
| Third Coat | Epoxy, Semi-gloss |

E. Gypsum Board Ceilings and Soffits - Painted:

| | |
|-------------|--------------------|
| First Coat | Suitable Primer |
| Second Coat | Latex Enamel, Flat |
| Third Coat | Latex Enamel, Flat |

END OF SECTION

DIVISION 10 – SPECIALTIES

SECTION 10 26 23

PROTECTIVE WALL COVERING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Plastic, impact-resistant, wall protection panels for wainscot.

1.02 SEQUENCING

- A. Apply panels to gypsum board substrate before adjacent gypsum board is painted.

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 catalog literature and technical data for each product supplied under this Section.
- C. Shop Drawings: Submit detail drawings indicating mounting details with the appropriate fasteners for indicated substrate materials.
- D. Samples: Submit 8 inch long samples in full size profile for verification of each product type and color indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Procedures: Submit for information and verification in accordance with Section 01 33 00.
- B. Test Reports: Include product test data demonstrating compliance with specified standards.

1.05 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Section 01 77 00.
 - 1. Submit cleaning and maintenance instructions for Owner's information.
 - 2. Warranty.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Fire Performance: Wall panels shall meet requirements for NFPA Class A fire rating.
 - 2. Wall Panels: UL labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. General Requirements: Comply with Section 01 60 00.
- B. Delivery: Deliver sheets in cartons. Deliver adhesive in sealed containers.
- C. Storage: Store products in original packaging in climate controlled area away from direct sunlight.

- D. Handling: Protect surface of panels during handling and installation.

1.08 SITE CONDITIONS

- A. Ambient Conditions: During installation and for not less than 48 hours before installation, maintain room temperature required for adhesive being used.
- B. Protection: 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- 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. Substitution Requests: In accordance with Section 01 25 00.

2.02 MATERIALS

- A. Wall Protection Panels: Vinyl/acrylic panels of gage indicated on Finish Legend.
 - 1. Size: Height as indicated by length required in one piece.
- B. Adhesive: Contact type as recommended by the manufacturer and complying with Southern California VOC regulations.
- C. Accessories and Trim: Manufacturer's standard vinyl/acrylic alloy moldings and trim.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Existing Conditions: Examine surfaces scheduled to receive panels for conditions that will adversely affect execution, permanence or quality of work. Report unsatisfactory conditions to the General Contractor in writing with copy to Architect.
- B. Acceptance: Beginning of application means acceptance of existing surfaces.

3.02 PREPARATION

- A. 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.

3.03 INSTALLATION

- A. General: Install panels in accordance with the manufacturer's recommendations.
- B. Adhesive: Comply with manufacturer's instructions regarding method of application, spread rate, drying time, open time and temperature and humidity limitations.

- C. 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.
- D. 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.
- E. Trim: Install trim at all exposed edges and outside corners.

3.04 CLEANING

- A. Immediately remove any adhesive from face of panels using solvent recommended by panel manufacturer. Keep faces clean during application.

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.

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.
- B. Substitution Requests: Required for all manufacturers and products not named as Basis of Design.
 - 1. Substitution requests for equivalent products by the following manufacturers will be accepted for review:
 - a. AJW Architectural Products; www.ajw.com.
 - b. American Specialties, Inc. (ASI); www.americanspecialties.com.
 - c. Bradley Corporation; www.bradleycorp.com.
 - d. Gamco, division of Bobrick Washroom Equipment, Inc.; www.gamcousa.com.
 - 2. Substitution requests for products by other manufacturers may or may not be reviewed at Architect's option.
 - 3. Submissions: Submit in accordance with Section 01 25 00.

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

DIVISION 11 – EQUIPMENT

SECTION 11 73 13

PSYCHIATRIC SECLUSION ROOM PADDING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Vinyl faced foam padding at partitions indicated.
- B. Related Requirements:
 - 1. Gypsum Board Finishing: Section 09 21 16 Gypsum Board Assemblies.
 - 2. Gypsum Board Primer: Section 09 91 23 Interior Painting.

1.02 SEQUENCING

- A. Do not begin installation until all wet work in space is completed and dry work above ceiling is completed.

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 technical and descriptive data sheets.
- C. Shop Drawings: Submit layout drawings indicating locations and padding sizes to be supplied.
 - 1. Indicate fastening pattern.
- D. Samples: Submit 3-inch square sample of padding with selected finish color for acceptance.

1.04 CLOSEOUT SUBMITTALS

- A. Submit following in accordance with Section 01 77 00.
 - 1. Operation and Maintenance Data: Manufacturer's printed, recommended cleaning and maintenance data.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General Requirements: Comply with Section 01 60 00 and with Manufacturer's recommendations.
- B. Storage and Handling Requirements:
 - 1. Storage: Store in clean, dry area.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products:
 - 1. Marathon Engineering Corporation; www.goldmedalsafetypadding.com – Gold Medal Safety Padding.

- B. 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 DESCRIPTION

- A. Padding: Prefabricated from synthetic resinous material into vertical panels.
 - 1. Facing: Kevlar or heavy duty vinyl as indicated on Drawings.
 - 2. Backing: 1-1/2 inch thick foam.
- B. Fire Resistance Rating: ASTM E84.
 - 1. Flame Spread: 5.
 - 2. Smoke Development: Less than 20.

2.03 ACCESSORIES

- A. Fasteners: As recommended by padding manufacturer.

PART 3 EXECUTION

- A. Verification of Conditions: Comply with Section 01 71 16.
 - 1. Existing Conditions: Inspect surfaces to receive padding.
- 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. Surface Preparation: Clean wall surfaces prior to padding installation.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Install padding panels vertically using mechanical fasteners.
- C. Fill gaps between panels with compound provided by manufacturer for this purpose.
- D. Fill fastener holes with color-matched compound and sand.

3.04 CLEANING

- A. Clean as recommended by manufacturer. Do not use materials or methods that may damage finish or surrounding construction.

3.05 PROTECTION

- A. Protect finished work until Substantial Completion.

END OF SECTION

DIVISION 12 – FURNISHINGS

SECTION 12 24 13

ROLLER WINDOW SHADES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Electrically operated window shades.
- B. Products Furnished But Not Installed Under This Section.
 - 1. Control Switches: Installed under Division 26 Electrical.
- C. Related Requirements:
 - 1. Wood Blocking and Grounds for Mounting Roller Shades and Accessories: Section 06 10 53 Miscellaneous Rough Carpentry.
 - 2. Electrical Power and Wiring: Division 26 Electrical.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: See Section 01 31 00.
 - 1. Coordinate with Division 26 to ensure power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements are provided.
 - 2. Coordinate with requirements of roller shade installer before inaccessible areas are constructed.
 - 3. Coordinate with Division 26 to ensure conduit with pull wire is provided in all areas that might not be accessible to roller shade installer due to building design, equipment location or schedule.
- B. Scheduling: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

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 all products to be supplied under this Section, with all selected options clearly identified, basic uses, materials, precautions and limitations, applicable standards, approvals, and general installation procedures. Include the following.
 - 1. Styles, material descriptions, dimensions of individual components, profiles, features, finishes.
 - 2. Mounting details.
 - 3. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual and lighting control systems as applicable.
- C. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- D. Samples:
 - 1. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements.

Shadecloth sample and aluminum finish sample as selected. Mark face of material to indicate interior faces.

1.04 INFORMATIONAL SUBMITTALS

- A. Procedures: Submit for information and verification in accordance with Section 01 33 00.
- B. Manufacturer's Instructions: Submit the following. Maintain one copy of each on site until completion of installation.
 - 1. Preparation instructions and recommendations.
 - 2. Installation instructions.

1.05 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Section 01 77 00.
 - 1. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.
 - 2. Operating instructions.
 - 3. Warranties.

1.06 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

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 shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.08 WARRANTY

- A. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating twenty-five year limited warranty.
- B. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating five-year warranty.
- C. Roller Shade Installation: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design Manufacturer and Products: See Finish Legend on Drawings.
 - 1. Manufacturer: MechoShade Systems, Inc.; www.mechoshade.com.
 - 2. Shadecloth Product: ThermoVeil 1010. Light Grey.
 - 3. Drive Bracket: Model Mecho/S.

- B. Substitution Requests: In accordance with Section 01 25 00.

2.02 REGULATORY REQUIREMENTS

- A. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.

2.03 DESCRIPTION

- A. Roller Shade Operation: Motorized.
- B. Mounting: Surface mounted with fascia.
- C. Configuration: Single solar shade cloth. Separate section in each window section.
- D. Hardware: Provide all operating hardware and support brackets.
 - 1. Access Requirements:
 - a. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
 - b. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.

2.04 PERFORMANCE

- A. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- B. Anti-Microbial Characteristics: 'No Growth' per ASTM G21 results for fungi.

2.05 SOLAR SHADECLOTH MATERIAL

- A. Shade cloth: Single thickness non-raveling 0.030-inch (0.762 mm) thick vinyl fabric, woven from 0.018-inch (0.457 mm) diameter extruded vinyl yarn comprising of 21 percent polyester and 79 percent reinforced vinyl.
 - 1. 2 to 3 percent open.
 - 2. Color: See Finish Legend on Drawings.

2.06 SHADE BAND ASSEMBLY

- A. General: Construction of shade band to include the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
- B. Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
- C. Shade Band and Shade Roller Attachment:
 - 1. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Roller tubes less than 1.55 inch (39.37 mm) in diameter are not acceptable.
 - 2. Provide for positive mechanical engagement with drive / brake mechanism.

3. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.
4. Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
5. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets are not acceptable.

2.07 HARDWARE

- A. Access and Material Requirements:
 1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
 2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
- B. Motorized Shade Hardware and Shade Brackets:
 1. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade.
 2. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
- C. Manual Operated Chain Drive Hardware and Brackets:
 1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
 2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
 3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
- D. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. (41 kg) minimum breaking strength.

2.08 SHADE MOTOR DRIVE SYSTEM

- A. Shade Motors:
 1. Tubular, asynchronous (non-synchronous) motors, with built-in reversible capacitor operating at 110v AC (60hz), single phase, temperature Class A, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor.
 2. Conceal motors inside shade roller tube.
 3. Maximum current draw for each shade motor of 2.3 amps.
 4. Use motors rated at the same nominal speed for all shades in the same room.
- B. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade motor and tube assembly.

2.09 MOTOR CONTROL SYSTEMS

- A. Specifications and design of shade motors and motor control system are based on the IQ/MLC motor logic control system manufactured by MechoShade Systems, Inc. Other systems may be acceptable provide that all of the following performance capabilities are provided. Motor logic

control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.

1. Motor Control System:

- a. Provide power to each shade motor via individual 3 conductor line voltage circuits connecting each motor to the relay based motor logic controllers (IQ/MLC).
- b. Control system components shall provide appropriate (spike and brown out) over-current protection (+/- 10 percent of line voltage) for each of the four individual motor circuits and shall be rated by UL or ETL as a recognized component of this system and tested as an integrated system.
- c. Motor control system shall allow each group of four shade motors in any combination to be controlled by each of four local switch ports, with up to fourteen possible "sub-group" combinations via local 3 button wall switches and all at once via a master 3 button switch. System shall allow for overlapping switch combinations from two or more local switches.
- d. Multiple "sub-groups" from different IQ/MLC control components shall be capable of being combined to form "groups" operated by a single 3 button wall switch, from either the master port or in series from a local switch port.
- e. Each shade motor shall be accessible (for control purposes) from up to four local switches and one master switch.
- f. Control system shall allow for automatic alignment of shade hem bars in stopped position at 25 percent, 50 percent, and 75 percent of opening heights, and up to three user-defined intermediate stopping positions in addition to all up / all down, regardless of shade height, for a total of five positions. Control system shall allow shades to be stopped at any point in the opening height noting that shades may not be in alignment at these non-defined positions).
- g. Control system shall have two standard operating modes: Normal mode allowing the shades to be stopped anywhere in the window's opening height and uniform mode, allowing the shades to only be stopped at the predefined intermediate stop positions. Both modes shall allow for all up / all down positioning.
- h. Control system components shall allow for interface with both audiovisual system components and building fire and life safety system via a dry contact terminal block.
- i. Control system components shall allow for interface with external analog input control devices such as solar activated controllers, 24 hour timers, and similar items; via a dry contact terminal block.
- j. Reconfiguration of switch groups shall not require rewiring of the hardwired line voltage motor power supply wiring, or the low voltage control wiring. Reconfiguration of switch groups shall be accomplished within the motor control device (IQ/MLC).

2. Wall Switches:

- a. Three-button architectural flush mounted switches with metal cover plate and no exposed fasteners.
- b. Connect local wall switches to control system components via low voltage (12V DC) 4-conductor modular cable equipped with RJ-11 type connectors supplied, installed and certified under Division 26 Electrical.
- c. Connect master wall switches to control system components via low voltage (12V DC) 6-conductor modular cable equipped with RJ-12 type connectors supplied, installed and certified under Division 26 Electrical.

2.10 FABRICATION

- A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
- B. Provide battens in standard shades as required to ensure proper tracking and uniform rolling of the shadebands. Contractor shall be responsible for ensuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible

for establishing appropriate standards to ensure proper tracking and rolling of the shadecloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

- C. For railroaded shadebands, provide seams in railroaded multi-width shadebands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards. In absence of such standards, ensure proper use of seams or battens as required to, and ensure the proper tracking of the railroaded multi-width shadebands.
- D. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer's standards. In absence of manufacturer's standards, be responsible for proper use and placement of battens to ensure proper tracking and roll of shadebands.

2.11 ACCESSORIES

- A. Fascia: Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
 - 1. Fascia shall be able to be installed across two or more shade bands in one piece.
 - 2. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
 - 3. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.
 - 4. Notching of fascia for manual chain shall not be acceptable.

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.

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. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow proper clearances for window operation hardware.
- B. Turn-Key Single-Source Responsibility for Motorized Interior Roller Shades: To control the responsibility for performance of motorized roller shade systems, assign the design, engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified in this Section to a single manufacturer and their authorized installer/dealer. The Architect will not produce a set of electrical drawings for the installation of control wiring for the motors, or motor controllers of the motorized roller shades. Power wiring (line voltage), shall be provided by the roller shade installer/dealer, in accordance with the

requirements provided by the manufacturer. Coordinate the following with the roller shade installer/dealer:

1. Run line voltage as dedicated home runs (of sufficient quantity, in sufficient capacity as required) terminating in junction boxes in locations designated on accepted shop drawings.
2. Provide and run all line voltage (from the terminating points) to the motor controllers, wire all roller shade motors to the motor controllers, and provide and run low voltage control wiring from motor controllers to switch/ control locations designated by the Architect. All above-ceiling and concealed wiring shall be plenum-rated, or installed in conduit, as required by the electrical code having jurisdiction.

3.04 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- B. Readjust at completion of Project if directed by Architect.

3.05 CLEANING

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

3.06 PROTECTION

- A. Protect installed products until completion of Project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

3.07 DEMONSTRATION AND TRAINING

- A. Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

END OF SECTION

SECTION 12 36 61

SIMULATED STONE COUNTERTOPS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Solid surfacing for countertops.
 - 2. Integral sinks where indicated.
- B. Related Requirements:
 - 1. Steel Supports: Section 05 50 00 Metal Fabrications.
 - 2. Plywood Subtops, Custom Cabinet and Countertop Construction: Section 06 41 00 Architectural Casework.

1.02 REFERENCES

- A. Reference Standards: See Section 01 42 00. Comply with following:
 - 1. Woodwork Institute (WI) Standards:
 - a. North American Architectural Woodwork Standards – 3.0 (NAAWS), July 1, 2016.
 - 1) Comply with Custom Grade if not otherwise specified.
 - 2) Seismic Installation Requirements: Annex 10E.

1.03 ACTION SUBMITTALS

- A. Procedures: Submit for review, acceptance and return in accordance with Section 01 33 00.
- B. Product Data: Submit catalog data for all countertop surfacing materials and countertop setting and grouting materials.
- C. Shop Drawings: Include the following.
 - a. Overall layout of countertop work.
 - b. Type, thickness, and details of countertop materials and components.
 - c. Joints, attachment and anchoring of components.
- D. Samples: Submit three sets of samples not less than 12-inch by 12-inch in size of each different color and finish of solid surfacing required. Include in each set the full range of exposed color and texture to be expected in the completed work. Review will be for color and texture only. Retain samples during construction as a standard for judging completed work.

1.04 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Section 01783.
 - 1. Maintenance Data: Submit for countertop surfacing materials. Include cleaning instructions, scratch removal procedures and materials harmful to facing.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer Qualifications: Provide supervision of installation by workmen skilled in this type of work with at least 5 years' experience in the installation of similar systems.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver no components to project site until areas are ready for installation.
- B. Storage: Store components indoors prior to installation.
- C. Handling: Handle materials to prevent damage to finished surfaces.
 - 1. Provide protective coverings to prevent physical damage or staining following installation for duration of Project.

1.07 AMBIENT CONDITIONS

- A. Solid Surfacing: Maintain ambient temperature between 50 and 95 degrees F for 48 hour before, during, and for minimum 7 days after installation of countertops.
- B. Comply with minimum temperature requirements of bonding and grouting materials manufacturers.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design Manufacturers and Products: See Finish Legend on Drawings.
- B. Substitution Requests: In accordance with Section 01 25 00.

2.02 MATERIALS

- A. Solid Surfacing Material: Solid, nonporous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment with through body colors meeting ANSI Z124.3 or ANSI Z124.6.
 - 1. Size: As indicated.
 - 2. Superficial damage to a depth of 0.010 inch (.25 mm) shall be repairable by sanding and/or polishing.

2.03 FABRICATION

- A. Field Measurements: Before fabricating countertops, verify shapes and dimensions of surfaces to be covered.
- B. WI Grade: Construct counters as indicated on Drawings and as required for WI Custom Grade work.
- C. Solid Surfacing Fabrication: Cut accurately to shape and dimensions shown on final shop drawings. Comply with the fabrication tolerances for the specified finishes.
 - 1. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed instructions and technical bulletins.
 - 2. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints. Dress joints (bed and vertical) straight and at 90 degree angle to face unless otherwise shown.
 - a. Reinforce with strip of solid polymer material, 2-inch wide.

- b. Joint Width: Cut for 1/8-inch joint width. Saw cut or roughly dress back surfaces that will be concealed in the finish work to approximately true planes. Fabricate work to profiles shown, with arises sharp and true, and match at joints between units.
- 3. Provide corners as detailed.
- 4. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.
- 5. Rout and finish component edges with clean, sharp returns.
 - a. Rout cutouts, radii and contours to template.
 - b. Smooth edges.
 - c. Repair or reject defective and inaccurate work.
- 6. Fabrication Tolerances:
 - a. Squareness: Panels shall have a maximum out of square (difference in length of the two diagonal face measurements) differential of not greater than 1/8-inch per 10 feet.
 - b. Warpage: Faces of panels shall not be out of plane more than 1/8-inch for each 10 feet of either height or width.

2.04 ACCESSORY PRODUCTS

- A. Joint Adhesive: Manufacturer's standard one- or two-part adhesive kit to create inconspicuous, nonporous joints.
- B. Sealant: Manufacturer's standard mildew-resistant, FDA-compliant, NSF 51-compliant (food zone — any type), UL-listed silicone sealant in colors matching components.
- C. Sink/Lavatory Mounting Hardware: Manufacturer's standard bowl clips, panel inserts and fasteners for attachment of undermount sinks/lavatories.
- D. Conductive Tape: Manufacturer's standard aluminum foil tape, with required thickness, for use with cutouts near heat sources.
- E. Insulating Felt Tape: Manufacturer's standard for use with conductive tape in insulating solid surface material from adjacent heat source.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Layout: Verify layout of work before beginning installation.
 - 2. Existing Conditions: Before beginning installation, examine surfaces to receive facing for defects or conditions adversely affecting quality and execution of installation.
 - 3. Allowable Substrate Tolerances:
 - a. Maximum variation in substrate surface: 1/8 inch in 8 feet.
 - b. Maximum height of abrupt irregularities: 1/32 inch.
 - 4. Notification: Notify Contractor and Architect of unsatisfactory conditions in writing.
- B. Acceptance: Beginning of work means acceptance of existing conditions by installer.

3.02 PREPARATION

- A. Protection: Protect adjoining work surfaces before work begins.

- B. Cleaning:
 - 1. Clean surfaces to remove loose and foreign matter that could impair adhesion.
 - 2. Clean panels before setting as recommended by Manufacturer.
- C. Surface Preparation: Where possible, correct substrate to conform to allowable substrate tolerances specified. Remove ridges and projections. Fill voids and depressions with patching compound compatible with setting materials and as recommended by Manufacturer.

3.03 INSTALLATION

- A. Solid Surfacing, General: Cut to size, seamed and installed with moisture-insensitive adhesive in accordance with Manufacturer's recommendations and as indicated on accepted shop drawings.
 - 1. Set with 1/8-inch joints between interior units.
 - 2. Minimize joints and pieces less than one half size.
 - 3. Job Cutting: Cut to size, seamed in accordance with Manufacturer's recommendations and as indicated on accepted shop drawings.
 - a. Employ skilled fitters for necessary cutting as the work progresses.
 - b. Locate cuts to be inconspicuous.
 - c. Fit units around projections and at perimeter.
 - d. Smooth and clean cut edges.
 - e. Ensure that trim will completely cover cut edges.
 - 4. Adjustments: Sound surfacing after setting. Replace hollow sounding units.
- B. Counters: Construct supports for counters as indicated. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data. Securely attach counters to walls and casework, plumb and level.
 - 1. Provide product in the largest pieces available.
 - 2. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
 - a. Exposed joints/seams shall not be allowed.
 - 3. Reinforce field joints with solid surface strips extending a minimum of 1 inch on either side of the seam with the strip being the same thickness as the top.
 - 4. Cut and finish component edges with clean, sharp returns.
 - 5. Rout radii and contours to template.
 - 6. Anchor securely to base cabinets or other supports.
 - 7. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
 - 8. Carefully dress joints smooth, remove surface scratches and clean entire surface.
 - 9. Install countertops with no more than 1/8-inch (3 mm) sag, bow or other variation from a straight line.
- C. Coved backsplashes and applied sidesplashes:
 - 1. Install applied sidesplashes using manufacturer's standard color-matched silicone sealant.
 - 2. Adhere applied sidesplashes to countertops using manufacturer's standard color-matched silicone sealant.

3.04 CLEANING

- A. Cleaning Solid Surfacing: Clean surfacing not less than 2 days after placement with non-abrasive cleaner. Follow manufacturer's instructions.

3.05 PROTECTION

- A. Protection: Protect completed work.

END OF SECTION

DIVISION 22 – PLUMBING

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Plumbing demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For the following:
 1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.
- B. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. 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 maximum thickness unless thickness or specific material is 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.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.05 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.06 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.07 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

- F. Split-Plate, Stamped-Steel Type: With exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.08 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with exposed-rivet hinge and set screw or spring clips.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.

- a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. 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.
- F. 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.04 PIPING CONNECTIONS

- A. 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.06 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

- C. Field Welding: Comply with AWS D1.1.

3.09 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.10 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Bronze angle valves.
 - 2. Bronze ball valves.
 - 3. Iron ball valves.
 - 4. Iron, single-flange butterfly valves.
 - 5. Iron, grooved-end butterfly valves.
 - 6. Bronze lift check valves.
 - 7. Bronze swing check valves.
 - 8. Iron swing check valves.
 - 9. Iron swing check valves with closure control.
 - 10. Iron, grooved-end swing check valves.
 - 11. Iron, center-guided check valves.
 - 12. Iron, plate-type check valves.
 - 13. Bronze gate valves.
 - 14. Iron gate valves.
 - 15. Bronze globe valves.
 - 16. Iron globe valves.
- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.03 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.04 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.05 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block 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

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.
- B. Class 125, Bronze Angle Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. NIBCO INC.
 - c. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.
- C. Class 150, Bronze Angle Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.

- b. Kitz Corporation.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.
- D. Class 150, Bronze Angle Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.03 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.

- b. Milwaukee Valve Company.
- c. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.04 IRON BALL VALVES

- A. Class 125, Iron Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Kitz Corporation.
 - c. Sure Flow Equipment Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.05 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.

- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

2.06 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 125, Lift Check Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Flo Fab Inc.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. Mueller Steam Specialty; a division of SPX Corporation.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: NBR, PTFE, or TFE.

2.07 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.

- i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.
- C. Class 150, Bronze Swing Check Valves with Bronze Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.

- f. Disc: PTFE or TFE.
- E. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Sure Flow Equipment Inc.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer.
 - e. Seat: EPDM.
- F. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Sure Flow Equipment Inc.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM.
- G. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer.
 - e. Seat: EPDM.

2.08 BRONZE GATE VALVES

- A. Class 125, NRS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:

- a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- B. Class 125, RS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- C. Class 150, NRS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- D. Class 150, RS Bronze Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.

- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.01 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.

3.02 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 chainwheels on operators for ball butterfly gate and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.03 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.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate, gate, or plug valves.

2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 3. Throttling Service: Globe or angle or ball or butterfly, ball, or butterfly valves.
 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 7. For Grooved-End Copper Tubing: Valve ends may be grooved.

3.05 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

- A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: One Two Three piece, full regular port, brass or bronze with brass bronze trim.
 3. Bronze Lift Check Valves: Class 125, bronze disc.
 4. Bronze Swing Check Valves: Class 125, bronze disc.
 5. Bronze Gate Valves: Class 125, NRS.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze stainless-steel disc.
 3. Iron, Grooved-End Butterfly Valves: 175 CWP.
 4. Iron Swing Check Valves: Class 125, metal seats.
 5. Iron, Grooved-End Swing Check Valves: 300 CWP.
 6. Iron, Center-Guided Check Valves: Class 125 Class 150, compact-wafer, metal seat.
 7. Iron, Plate-Type Check Valves: Class 125 Class 150; single plate; metal seat.
 8. Iron Gate Valves: Class 125, NRS.

3.06 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG)

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: One Two piece, full port, brass or bronze with bronze trim.
 3. Bronze Lift Check Valves: Class 125, bronze disc.
 4. Bronze Swing Check Valves: Class 125, disc.
 5. Bronze Gate Valves: Class 125,.

- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, disc.

3.07 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 125, bronze disc.
 - 3. Ball Valves: One Two piece, full regular port, bronze with bronze trim.
 - 4. Bronze Swing Check Valves: Class 125, bronze disc.
 - 5. Bronze Gate Valves: Class 125,.
 - 6. Bronze Globe Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron Ball Valves: Class 150.
 - 3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM NBR seat, aluminum-bronze disc.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 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 Sections:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- 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.

1.05 SUBMITTALS

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

- 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. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
- C. Delegated-Design Submittal: For 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 trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.
- D. Welding certificates.

1.06 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.

PART 2 PRODUCTS

2.01 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: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 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 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.

2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, 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.

2.03 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. B-Line, an Eaton Company.
 - b. Flex-Strut Inc.
 - c. Unistrut Corporation; Part of Atkore International.
 - d. Wesanco, Inc.
 - 3. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - 4. Standard: MFMA-4.
 - 5. Channels: Continuous slotted steel channel with inturned lips.
 - 6. Channel Nuts: Formed or stamped steel 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.
 - 8. Metallic Coating: Electroplated zinc.
 - 9. Paint Coating: Vinyl.
 - 10. Plastic Coating: Epoxy.
 - 11. Combination Coating: None.
- B. Non-MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anvil International.
 - b. Haydon Corporation.
 - c. PHD Manufacturing, Inc.
 - 3. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 4. Standard: Comply with MFMA-4.
 - 5. Channels: Continuous slotted steel channel with inturned lips.
 - 6. Channel Nuts: Formed or stamped steel 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.
 - 8. Coating: Paint.

2.04 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - 1. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 - 2. Piping Technology & Products, Inc.
 - 3. Rilco Manufacturing Co., Inc.
 - 4. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.05 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 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: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

- F. Curb-Mounting-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.

2.07 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.08 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.09 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

- G. 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. 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.
- H. 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 Division 07 Section "Roof Accessories" for curbs.
- I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. 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.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. 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.
- Q. 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.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 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.

3.02 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.

3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M 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.

3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 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: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use 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 fiberglass pipe hangers and fiberglass strut systems and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel 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 not necessary.
 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 not necessary.
 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-69 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 where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.03 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.

1.04 COORDINATION

- 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.

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch 1/8 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: Black Yellow.
 3. Background Color: White.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. 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), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black, White.
- 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-fourths the size of principal lettering.

- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- 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, 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 1-1/2 inches high.

2.04 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Aluminum.
 - 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.05 VALVE TAGS

- A. 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 minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link 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.

2.06 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
 - 1. Low-Pressure, Compressed-Air Piping:
 - a. Background Color: Green.
 - b. Letter Color: Black.

2. Medium-Pressure, Compressed-Air Piping:
 - a. Background Color: Green .
 - b. Letter Color: Black.
3. Domestic Water Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
4. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: Black.

3.04 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 2 inches, square.
 - b. Hot Water: 1-1/2 inches 2 inches, round.
 - c. Low-Pressure Compressed Air: 2 inches, round.
 - d. High-Pressure Compressed Air: 2 inches, round.
 2. Valve-Tag Color:
 - a. Cold Water: Green.
 - b. Hot Water: Green.
 - c. Low-Pressure Compressed Air: Green.
 - d. High-Pressure Compressed Air: Green.
 3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.
 - c. Low-Pressure Compressed Air: Black.
 - d. High-Pressure Compressed Air: Black.

3.05 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Calcium silicate.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - d. Phenolic.
 - e. Polyisocyanurate.
 - f. Polyolefin.
 - g. Polystyrene.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Lagging adhesives.
 - 6. Sealants.
 - 7. Factory-applied jackets.
 - 8. Field-applied fabric-reinforcing mesh.
 - 9. Field-applied cloths.
 - 10. Field-applied jackets.
 - 11. Tapes.
 - 12. Securements.
 - 13. Corner angles.
- B. Related Sections include the following:
 - 1. Division 21 Section "Fire-Suppression Systems Insulation."
 - 2. Division 23 Section "HVAC Insulation."

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.

6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
 8. Detail field application for each equipment type.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
1. Sample Sizes:
 - a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - b. Sheet Form Insulation Materials: 12 inches square.
 - c. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - d. Sheet Jacket Materials: 12 inches square.
 - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Qualification Data: For qualified Installer.
- E. 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.
- F. Field quality-control reports.

1.04 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting 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 and inspecting 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. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
1. Piping Mockups:
 - a. One 10-foot section of NPS 2 straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.

2. Equipment Mockups: One tank or vessel.
3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
4. Notify Architect seven days in advance of dates and times when mockups will be constructed.
5. Obtain Architect's approval of mockups before starting insulation application.
6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Demolish and remove mockups when directed.

1.05 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.

1.06 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.
- C. Coordinate installation and testing of heat tracing.

1.07 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

2.01 INSULATION MATERIALS

- A. Comply with requirements in Part 3 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 C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Industrial Insulation Group (The); Thermo-12 Gold.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- I. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; HTB 23 Spin-Glas.
 - b. Owens Corning; High Temperature Flexible Batt Insulations.
- J. Phenolic:
 - 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Kingspan Corp.; Koolphen K.
 - 2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.

3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
 - b. Board for Equipment Applications: ASJ.
- K. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Apache Products Company; ISO-25.
 - b. Dow Chemical Company (The); Trymer.
 - c. Duna USA Inc.; Corafoam.
 - d. Elliott Company; Elfoam.
 2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
 3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
 4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Pipe Applications: ASJ.
 - b. Equipment Applications: ASJ.
- L. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. RBX Corporation; Therma-cell.
- M. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Styrofoam.
 - b. Knauf Insulation; Knauf Polystyrene.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.

- b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

2.03 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.
 - 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-97.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
 - c. Marathon Industries, Inc.; 290.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
 - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
 - 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 97-13.
- F. 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.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 4. Service Temperature Range: Minus 50 to plus 180 deg F.
 5. Color: White.

2.05 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.

2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 3. Materials shall be compatible with insulation materials, jackets, and substrates.
 4. Permanently flexible, elastomeric sealant.
 5. Service Temperature Range: Minus 100 to plus 300 deg F.
 6. Color: White or gray.
 7. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.
 6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.07 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, provide the following provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 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.
 5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.

- c. RPR Products, Inc.; Insul-Mate.
- 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-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 2-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. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 - 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.

2.08 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 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. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.

- b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
- 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 - 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.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
- 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 - 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.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
- 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 - 2. Width: 3 inches.
 - 3. Film Thickness: 4 mils.
 - 4. Adhesive Thickness: 1.5 mils.
 - 5. Elongation at Break: 145 percent.
 - 6. Tensile Strength: 55 lbf/inch in width.

2.09 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 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.
 - a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness

indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

- a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-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. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.
 - b. Childers Products.

- c. PABCO Metals Corporation.
- d. RPR Products, Inc.

2.10 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: 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 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 trade 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.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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 application and finishing.
- 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 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.
 - 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 as recommended by insulation material manufacturer 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 75 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 similar 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. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.04 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 Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall 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 wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. 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 Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.05 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, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as 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 or sectional pipe insulation of same material and thickness as 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 or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 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.
 - 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. 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 adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two 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.

3.06 CALCIUM SILICATE INSULATION INSTALLATION

- A. Insulation Installation on Domestic Water Boiler Breechings:
 1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
 3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.
- B. Insulation Installation on Straight Pipes and Tubes:
 1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
 3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- C. 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 block insulation of same material and thickness as pipe insulation.
 4. Finish flange insulation same as pipe insulation.

- D. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
 - 3. Finish fittings insulation same as pipe insulation.
- E. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 2. Install insulation to flanges as specified for flange insulation application.
 - 3. Finish valve and specialty insulation same as pipe insulation.

3.07 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- 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 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 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.

3.08 MINERAL-FIBER INSULATION INSTALLATION

- 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 but 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 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 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.

3.09 PHENOLIC INSULATION INSTALLATION

- A. General Installation Requirements:
1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
- B. 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 with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- C. 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 block insulation of same material and thickness as pipe insulation.
- D. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- E. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
 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.

3.10 POLYISOCYANURATE INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.
- 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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.
- C. Insulation Installation on Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of polyisocyanurate 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.

3.11 POLYOLEFIN INSULATION INSTALLATION

- 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 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.

3.12 POLYSTYRENE INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.
- 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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed section of polystyrene 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.

3.13 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. 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.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. 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.
- E. Where PVDC jackets are indicated, install as follows:
 - 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 - 2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 - 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 - 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 - 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.14 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.15 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 field-insulated equipment, 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 type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. 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.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.16 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE

- A. Round, exposed breeching and connector insulation shall be one of the following:
 - 1. Calcium Silicate: 4 inches thick.
 - 2. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
 - 3. High-Temperature Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- B. Round, concealed breeching and connector insulation shall be one of the following:
 - 1. Calcium Silicate: 4 inches thick.
 - 2. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
 - 3. High-Temperature Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.

- C. Rectangular, exposed breeching and connector insulation shall be one of the following:
 - 1. Calcium Silicate: 4 inches thick.
 - 2. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
 - 3. High-Temperature Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- D. Rectangular, concealed breeching and connector insulation shall be one of the following:
 - 1. Calcium Silicate: 4 inches thick.
 - 2. High-Temperature Mineral-Fiber Blanket: 3 inches thick and 3-lb/cu. ft. nominal density.
 - 3. High-Temperature Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.

3.17 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

3.18 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. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.19 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Phenolic: 1 inch thick.
 - c. Polyisocyanurate: 1 inch thick.
 - d. Polyolefin: 1/2 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Phenolic: 1 inch thick.
 - c. Polyisocyanurate: 1 inch thick.
 - d. Polyolefin: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. 2" and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
 - b. Phenolic: 1 inch thick.
 - c. Polyisocyanurate: 1 inch thick.
 - d. Polyolefin: 3/4 inch thick.
- C. Domestic Chilled Water (Potable):
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.

- b. Phenolic: 1 inch thick.
 - c. Polyisocyanurate: 1 inch thick.
 - d. Polyolefin: 1 inch thick.
- D. Stormwater and Overflow:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Phenolic: 1 inch thick.
 - d. Polyisocyanurate: 1 inch thick.
 - e. Polyolefin: 1 inch thick.
- E. Roof Drain and Overflow Drain Bodies:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Phenolic: 1 inch thick.
 - c. Polyisocyanurate: 1 inch thick.
 - d. Polyolefin: 1 inch thick.
- F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Polyolefin: 1/2 inch thick.
- G. Sanitary Waste Piping Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Phenolic: 1-1/2 inches thick.
 - b. Polyisocyanurate: 1-1/2 inches thick.
- H. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - c. Phenolic: 1 inch thick.
 - d. Polyisocyanurate: 1 inch thick.
 - e. Polyolefin: 3/4 inch thick.
- I. 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. Flexible Elastomeric: 3/4 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - c. Phenolic: 1 inch thick.
 - d. Polyisocyanurate: 1 inch thick.
 - e. Polyolefin: 3/4 inch thick.
- J. Hot Service Drains:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Calcium Silicate: 1-1/2 inches thick.
- K. Hot Service Vents:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Calcium Silicate: 1-1/2 inches thick.

- b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.20 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - c. Phenolic: 2 inches thick.
 - d. Polyisocyanurate: 2 inches thick.
 - e. Polyolefin: 2 inches thick.
 - f. Polystyrene: 2 inches thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - c. Phenolic: 2 inches thick.
 - d. Polyisocyanurate: 2 inches thick.
 - e. Polyolefin: 2 inches thick.

3.21 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Loose-fill insulation, for belowground piping, is specified in Division 33 piping distribution Sections.
- B. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.
- C. Chilled Water, All Sizes: Cellular glass, 2 inches thick.

3.22 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. Equipment, Concealed:
 - 1. None.
 - 2. PVC: 20 mils thick.
 - 3. Aluminum, Smooth: 0.016 inch thick.
 - 4. Painted Aluminum, Smooth: 0.016 inch thick.
 - 5. Stainless Steel, Type 304,: 0.010 inch thick.

3.23 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, Exposed:
 - 1. PVC: 20 mils thick.

2. Painted Aluminum,: 0.016 inch thick.
3. Stainless Steel, Type 304, Smooth 2B Finish: 0.010 inch thick.

3.24 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Encasement for piping.
 - 3. Specialty valves.
 - 4. Flexible connectors.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
 - 7. Wall penetration systems.

1.03 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.04 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Backflow preventers and vacuum breakers.
 - 6. Escutcheons.
 - 7. Sleeves and sleeve seals.
 - 8. Water penetration systems.
- B. Water Samples: Specified in "Cleaning" Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. Compressed air piping.
 - 4. HVAC hydronic piping.
- D. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61 for potable domestic water piping and components.

1.06 PROJECT 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 5 days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Owner's written permission.

1.07 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

- A. 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.

2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. 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.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.03 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
 - 2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Plain-End, Ductile-Iron Pipe: AWWA C151.
 - 1. Grooved-Joint, Ductile-Iron-Pipe Appurtenances:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Star Pipe Products.
 - 4) Victaulic Company.
- b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
- c. Grooved-End, Ductile-Iron-Pipe Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

2.04 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B, Standard Weight. Include ends matching joining method.
 - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
 - 2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
 - 3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
 - 4. Flanges: ASME B16.1, Class 125, cast iron.
 - 5. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Star Pipe Products.
 - 4) Victaulic Company.
 - b. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - c. Grooved-End-Pipe Couplings for Galvanized-Steel Piping: AWWA C606 for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

2.05 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; 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 B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. and material recommended by piping system manufacturer unless otherwise indicated.

2.06 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Sheet or Tube.
- C. Material: LLDPE film of 0.008-inch minimum thickness.
- D. Color: Black or Natural.

2.07 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

2.08 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. EPCO Sales, Inc.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - d. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - 2. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. EPCO Sales, Inc.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Pipeline Seal and Insulator, Inc.
 - 2. 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 Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
 - 2. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.
- F. Dielectric Nipples:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.
 - 2. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.09 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flex-Hose Co., Inc.
 - 2. Hyspan Precision Products, Inc.
 - 3. Mercer Rubber Co.
 - 4. Metraflex, Inc.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 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 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.10 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with exposed-rivet hinge, setscrew.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.11 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.12 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.13 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. SIGMA.
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 - 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
 - 2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
 - 3. Housing-to-Sleeve Gasket: EPDM rubber.
 - 4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
 - 5. Pipe Sleeve: AWWA C151, ductile-iron pipe or ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe.

2.14 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

- 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 ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level without pitch and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. 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.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping adjacent to equipment and specialties to allow service and maintenance.
- O. Install piping to permit valve servicing.
- P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- Q. Install piping free of sags and bends.
- R. Install fittings for changes in direction and branch connections.
- S. Install PEX piping with loop at each change of direction of more than 90 degrees.
- T. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- U. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- V. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- W. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.03 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: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.
- G. Steel-Piping Grooved Joints: Cut or roll groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- H. 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.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Piping: Join according to ASTM D 2855.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.05 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.06 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.07 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.08 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. 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.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 6. NPS 6: 10 feet with 5/8-inch rod.
 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.

3.09 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow 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 required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 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.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 5. Bare Piping in Equipment Rooms: One piece, stamped steel with spring clips.
 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - d. Do not use sleeves when wall penetration systems are used.
 - 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.

- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 WALL PENETRATION SYSTEM INSTALLATION

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.14 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.15 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. 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:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. 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.

3. 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.
 4. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 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 for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.16 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 flow of hot water 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. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.17 CLEANING

- A. Clean and disinfect potable and 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 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- 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.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.18 PIPING SCHEDULE

- 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:
 1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
 1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.
 2. Mechanical-joint, ductile-iron pipe; standard- or compact- pattern mechanical-joint fittings; and mechanical joints.
 3. Push-on-joint, ductile-iron pipe; standard- or compact- pattern push-on-joint fittings; and gasketed joints.
 4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- F. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:
 1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.
- G. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 2. Hard copper tube, ASTM B 88, Type L; copper solder-joint fittings; and brazed joints.
 3. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
 4. Hard copper tube, ASTM B 88, Type L; copper push-on-joint fittings; and push-on joints.

3.19 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Balancing valves.
 - 3. Temperature-activated water mixing valves.
 - 4. Strainers.
 - 5. Outlet boxes.
 - 6. Hose stations.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Drain valves.
 - 10. Water hammer arresters.
 - 11. Air vents.
 - 12. Trap-seal primer valves.
 - 13. Trap-seal primer systems.
- B. Related Sections include the following:
 - 1. Division 22 Section "Domestic Water Piping" for water meters.
 - 2. Division 22 Section "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.

1.03 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 PRODUCTS

2.01 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - 3. Standard: ASSE 1001.
 - 4. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 5. Body: Bronze.
 - 6. Inlet and Outlet Connections: Threaded.
 - 7. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
 - 3. Standard: ASSE 1011.
 - 4. Body: Bronze, nonremovable, with manual drain.
 - 5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 6. Finish: Chrome or nickel plated.
- C. Pressure Vacuum Breakers:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Flomatic Corporation.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
 4. Standard: ASSE 1020.
 5. Operation: Continuous-pressure applications.
 6. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 7. Size: Varies
 8. Design Flow Rate: Varies
 9. Selected Unit Flow Range Limits: Varies
 10. Pressure Loss at Design Flow Rate:
 11. Accessories:
 - a. Valves: Ball type, on inlet and outlet.
- D. Laboratory-Faucet Vacuum Breakers:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 3. Standard: ASSE 1035.
 4. Size: NPS 1/4 or NPS 3/8 matching faucet size.
 5. Body: Bronze.
 6. End Connections: Threaded.
 7. Finish: Chrome plated.

2.02 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Legend Valve.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 3. Standard: ASSE 1012.
 4. Operation: Continuous-pressure applications.
 5. Size: NPS 3/4.
 6. Body: Bronze.
 7. End Connections: Union, solder joint.
 8. Finish: Chrome plated.

2.03 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Armstrong International, Inc.
 - b. ITT Industries; Bell & Gossett Div.
 - c. Taco, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 4. Type: Ball valve with two readout ports and memory setting indicator.
 5. Body: bronze,
 6. Size: Same as connected piping, but not larger than NPS 2.
 7. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Cast-Iron Calibrated Balancing Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Watts Industries, Inc.; Water Products Div.
 4. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
 5. Size: Same as connected piping, but not smaller than NPS 2-1/2.
- C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- D. Memory-Stop Balancing Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Stockham Div.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Red-White Valve Corp.
 3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 4. Pressure Rating: 400-psig minimum CWP.
 5. Size: NPS 2 or smaller.
 6. Body: Copper alloy.
 7. Port: Standard or full port.
 8. Ball: Chrome-plated brass.

9. Seats and Seals: Replaceable.
10. End Connections: Solder joint or threaded.
11. Handle: Vinyl-covered steel with memory-setting device.

2.04 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Armstrong International, Inc.
 - b. Leonard Valve Company.
 - c. Symmons Industries, Inc.
 - d. Taco, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 4. Standard: ASSE 1017.
 5. Pressure Rating: 125 psig.
 6. Type: Thermostatically controlled water mixing valve.
 7. Material: Bronze body with corrosion-resistant interior components.
 8. Connections: Threaded union inlets and outlet.
 9. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 10. Valve Finish: Chrome plated.

2.05 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger:
 6. Drain: Factory-installed, hose-end drain valve.

2.06 OUTLET BOXES

- A. Clothes Washer Outlet Boxes:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.

- d. LSP Products Group, Inc.
 - e. Oatey.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies.
 - g. Symmons Industries, Inc.
 - h. Watts Industries, Inc.; Water Products Div.
 - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
 - j. Zurn Plumbing Products Group; Light Commercial Operation.
- 3. Mounting: Recessed.
 - 4. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
 - 5. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
 - 6. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
 - 7. Drain: NPS 1-1/2 standpipe and P-trap for direct waste connection to drainage piping.
 - 8. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
 - 9. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

2.07 HOSE STATIONS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ARCHON Industries, Inc.
 - 2. Armstrong International, Inc.
 - 3. DynaFluid Ltd.
 - 4. Leonard Valve Company.
- C. Single-Temperature-Water Hose Stations:
 - 1. Standard: ASME A112.18.1.
 - 2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
 - 3. Hose-Rack Material: Stainless steel.
 - 4. Body Material: Bronze.
 - 5. Body Finish: Rough bronze.
 - 6. Mounting:
 - 7. Supply Fitting: NPS 1/2 gate, globe, or ball valve and check valve and NPS 1/2 copper, water tubing. Omit check valve if check stop is included with fitting.
 - 8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 25 feet long.
 - 9. Nozzle: With hand squeeze on-off control.
 - 10. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

2.08 HOSE BIBBS

- A. Hose Bibbs:
 - 1. Standard: ASME A112.18.1 for sediment faucets.

2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.09 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
4. Pressure Rating: 125 psig.
5. Operation: Loose key.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 3/4 or NPS 1.
8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Box: Deep, flush mounting with cover.
10. Box and Cover Finish: Polished nickel bronze.
11. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
12. Nozzle and Wall-Plate Finish: Polished nickel bronze.
13. Operating Keys(s): One with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Arrowhead Brass Products, Inc.
- b. Mansfield Plumbing Products LLC.
- c. McDonald, A. Y. Mfg. Co.
- d. Prier Products, Inc.
- e. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
- f. Watts Industries, Inc.; Water Products Div.
- g. Woodford Manufacturing Company.
- h. Zurn Plumbing Products Group; Light Commercial Operation.
3. Standard: ASSE 1019, Type A or Type B.
4. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
5. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
6. Pressure Rating: 125 psig.
7. Operation: Loose key.
8. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
9. Inlet: NPS 1/2 or NPS 3/4.
10. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.10 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig minimum CWP.
 3. Size: NPS 3/4.
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded or solder joint.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
- B. Gate-Valve-Type, Hose-End Drain Valves:
 1. Standard: MSS SP-80 for gate valves.
 2. Pressure Rating: Class 125.
 3. Size: NPS 3/4.
 4. Body: ASTM B 62 bronze.
 5. Inlet: NPS 3/4 threaded or solder joint.
 6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
- C. Stop-and-Waste Drain Valves:
 1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
 2. Pressure Rating: 200-psig minimum CWP or Class 125.
 3. Size: NPS 3/4.
 4. Body: Copper alloy or ASTM B 62 bronze.
 5. Drain: NPS 1/8 side outlet with cap.

2.11 WATER HAMMER ARRESTERS

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

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Metal bellows.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.12 AIR VENTS

- A. Bolted-Construction Automatic Air Vents:
 1. Body: Bronze.
 2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
 3. Float: Replaceable, corrosion-resistant metal.
 4. Mechanism and Seat: Stainless steel.
 5. Size: NPS 1/2 minimum inlet.
 6. Inlet and Vent Outlet End Connections: Threaded.
- B. Welded-Construction Automatic Air Vents:
 1. Body: Stainless steel.
 2. Pressure Rating: 150-psig minimum pressure rating.
 3. Float: Replaceable, corrosion-resistant metal.
 4. Mechanism and Seat: Stainless steel.
 5. Size: NPS 3/8 minimum inlet.
 6. Inlet and Vent Outlet End Connections: Threaded.

2.13 TRAP-SEAL PRIMER VALVES

- A. Supply-Type, Trap-Seal Primer Valves:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 3. Standard: ASSE 1018.
 4. Pressure Rating: 125 psig minimum.
 5. Body: Bronze.
 6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

- B. Drainage-Type, Trap-Seal Primer Valves:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - 3. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
 - 4. Size: NPS 1-1/4 minimum.
 - 5. Material: Chrome-plated, cast brass.

2.14 TRAP-SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Systems:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. PPP Inc.
 - 4. Standard: ASSE 1044,
 - 5. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
 - 6. Cabinet: Recessed-mounting steel box with stainless-steel cover.
 - 7. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - 8. Vacuum Breaker: ASSE 1001.
 - 9. Number Outlets: Four.
 - 10. Size Outlets: NPS 1/2.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers 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 not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve,.
- H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install shutoff valve on outlet if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- J. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- K. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.
- L. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.
- M. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.
- N. Install water hammer arresters in water piping according to PDI-WH 201.
- O. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- P. Install supply-type, trap-seal primer valves 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.
- Q. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- R. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check backflow-prevention assemblies.
 - 5. Carbonated-beverage-machine backflow preventers.
 - 6. Dual-check-valve backflow preventers.
 - 7. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
 - 8. Double-check, detector-assembly backflow preventers.
 - 9. Water pressure-reducing valves.
 - 10. Calibrated balancing valves.
 - 11. Primary, thermostatic, water mixing valves.
 - 12. Manifold, thermostatic, water-mixing-valve assemblies.
 - 13. Photographic-process, thermostatic, water-mixing-valve assemblies.
 - 14. Primary water tempering valves.
 - 15. Outlet boxes.
 - 16. Hose stations.
 - 17. Supply-type, trap-seal primer valves.
 - 18. Trap-seal primer systems.
- 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 Division 22 Section "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Sewerage Pumps."
 - 2. Division 22 Section "Chemical Waste-Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.03 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.04 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.
 - 2. Sanitary Sewer, Force-Main Piping: 50 psig 100 psig.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.05 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

- B. Shop Drawings:
 - 1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
 - 2. Sovent Drainage System: Include plans, elevations, sections, and details.
- C. Field quality-control inspection and test reports.

1.06 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.04 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

- a. Available Manufacturers:
 - 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, minimum (4) stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) ANACO.
 - 2) Clamp-All Corp.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) MG Piping Products Co.
- D. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 1. Available Manufacturers:
 - a. ANACO.

2.05 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.
- B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
- C. Pressure Fittings:
 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
 4. Cast-Iron Flanges: ASME B16.1, Class 125.
 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
- D. Grooved-Joint Systems:
 1. Available Manufacturers:
 - a. Anvil International.
 - b. Star Pipe Products; Star Fittings Div.
 - c. Victaulic Company.
 - d. Ward Manufacturing, Inc.
 2. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, galvanized, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
 3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.06 STAINLESS-STEEL PIPE AND FITTINGS

- A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.
- B. Gaskets: Lip seals shaped to fit socket groove, with plastic backup ring.
 - 1. Material: EPDM, unless NBR is indicated.

2.07 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint Systems:
 - 1. Available Manufacturers:
 - a. Victaulic Company.
 - 2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - 3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.

2.08 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 3. 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.
- C. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.09 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.

- B. Form: Sheet or tube.
- C. Color: Black or natural.

PART 3 EXECUTION

3.01 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

- 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. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
 - 4. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
 - 5. Copper DWV tube, copper drainage fittings, and soldered joints.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
 - 4. Stainless-steel pipe and fittings gaskets, and gasketed joints.
 - 5. Copper 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.
- E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; standard, and heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 - 1. Extra-Heavy Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel heavy-duty shielded, cast-iron and rigid, unshielded couplings; and hubless-coupling joints.
 - 3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
- G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Extra-Heavy Service class, cast-iron soil piping; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
- H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:
1. Hard copper tube, Type L Type M; copper pressure fittings; and soldered joints.
 2. Steel pipe, pressure fittings, and threaded joints.
- I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be any of the following:
1. Hard copper tube, Type L Type M; copper pressure fittings; and soldered joints.
 2. Steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end steel pipe, grooved-joint system fittings and couplings, and grooved joints.
- J. Underground sanitary-sewage force mains NPS 4 and smaller shall be any of the following:
1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
 2. Steel pipe, pressure fittings, and threaded joints.
 - a. Include grooved-joint system fittings and couplings and grooved joints where indicated.
 3. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile-iron fittings; glands, gaskets, and bolts; and mechanical joints.
 - a. Include grooved-joint system fittings and couplings and grooved joints where indicated.
 4. Push-on-joint, ductile-iron pipe; push-on-joint ductile-iron fittings; gaskets; and gasketed joints.
 - a. Include grooved-joint system fittings and couplings and grooved joints where indicated.
 5. Pressure pipe couplings, if dissimilar pipe materials or piping with small difference in OD must be joined.

3.03 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- F. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.
- G. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
1. Install encasement on piping according to ASTM A 674 or AWWA C105.

- H. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- I. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- J. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- K. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- L. 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."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- M. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- N. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- O. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- P. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- Q. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- R. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- S. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

- T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. 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.
- C. 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.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- G. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.05 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Install gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.06 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:

- 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.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6: 60 inches with 3/4-inch rod.
 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6: 12 feet with 3/4-inch rod.
 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 2: 84 inches with 3/8-inch rod.
 2. NPS 3: 96 inches with 1/2-inch rod.
 3. NPS 4: 108 inches with 1/2-inch rod.
 4. NPS 6: 10 feet with 5/8-inch rod.
- K. Install supports for vertical stainless-steel piping every 10 feet.
- L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
 6. NPS 8: 10 feet with 3/4-inch rod.

- M. Install supports for vertical copper tubing every 10 feet.
- N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 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 drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage 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 drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 - 1. Sanitary Sewer: To exterior force main or sanitary manhole.
 - 2. Sewage Pumps: To sewage pump discharge.

3.08 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 drainage 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. 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 drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. 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. 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. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. 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.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.09 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains 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.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Floor drains.
 - 4. Trench drains.
 - 5. Channel drainage systems.
 - 6. Air-admittance valves.
 - 7. Roof flashing assemblies.
 - 8. Through-penetration firestop assemblies.
 - 9. Miscellaneous sanitary drainage piping specialties.
 - 10. Flashing materials.
- B. Related Sections include the following:
 - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
 - 2. Division 22 Section "Plumbing Fixtures" for hair interceptors.
 - 3. Division 22 Section "Healthcare Plumbing Fixtures" for plaster sink interceptors.

1.03 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Plumbing Specialties.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that Plumbing accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 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.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.06 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.01 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.

- b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 4. Standard: ASME A112.14.1.
 - 5. Size: Same as connected piping.
 - 6. Body: Cast iron.
 - 7. Cover: Cast iron with bolted or threaded access check valve.
 - 8. End Connections: Hubless.
 - 9. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
 - 10. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:
- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 3. Size: Same as floor drain outlet.
 - 4. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 - 5. Check Valve: Removable ball float.
 - 6. Inlet: Threaded.
 - 7. Outlet: Threaded or spigot.

2.02 CLEANOUTS

- A. Exposed Metal Cleanouts:
- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Josam Company; Blucher-Josam Div.
 - 4. Standard: ASME A112.36.2M for cast iron ASME A112.3.1 for stainless steel for cleanout test tee.
 - 5. Size: Same as connected drainage piping
 - 6. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 7. Closure: Countersunk, plug.
 - 8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

9. Closure: Stainless-steel plug with seal.
- B. Metal Floor Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
 - i. Josam Company; Josam Div.
 - j. Kusel Equipment Co.
 - k. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - l. Josam Company; Blucher-Josam Div.
 4. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
 5. Size: Same as connected branch.
 6. Type: Heavy-duty, adjustable housing.
 7. Body or Ferrule: Cast iron.
 8. Clamping Device: Required.
 9. Outlet Connection: Threaded.
 10. Closure: Brass plug with straight threads and gasket.
 11. Adjustable Housing Material: Cast iron.
 12. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
 13. Frame and Cover Shape: Round.
 14. Top Loading Classification: Extra Heavy Duty.
 15. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
 16. Standard: ASME A112.3.1.
 17. Size: Same as connected branch.
 18. Housing: Stainless steel.
 19. Closure: Stainless steel with seal.
 20. Riser: Stainless-steel drainage pipe fitting to cleanout.
- C. Cast-Iron Wall Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 4. Standard: ASME A112.36.2M. Include wall access.

5. Size: Same as connected drainage piping.
6. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
7. Closure: Countersunk, plug.
8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
9. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
10. Wall Access: Round, wall-installation frame and cover.

2.03 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.6.3.
5. Pattern: Floor drain.
6. Body Material: Gray iron.
7. Seepage Flange: Required.
8. Anchor Flange: Required.
9. Clamping Device: Required.
10. Outlet: Bottom.
11. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
12. Sediment Bucket: Not required.
13. Top or Strainer Material: Stainless steel.
14. Top of Body and Strainer Finish: Stainless steel.
15. Top Shape: See Architectural Plan.
16. Dimensions of Top or Strainer:
17. Top Loading Classification: Heavy Duty.
18. Funnel: Not required.
19. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
20. Trap Material: Cast iron.
21. Trap Pattern: Standard P-trap.
22. Trap Features: Trap-seal primer valve drain connection.

B. Stainless-Steel Floor Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

- a. Josam Company; Blucher-Josam Div.
- b. Josam Company; Josam Div.
- c. Kusel Equipment Co.
- d. Scherping Systems, Inc.
- e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- f. Tyler Pipe; Wade Div.
- g. Watts Drainage Products Inc.
- h. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.3.1.
5. Outlet: Bottom.
6. Top or Strainer Material: Stainless steel.
7. Top Shape: See Plans.
8. Dimensions of Top or Strainer:
9. Seepage Flange: Required.
10. Anchor Flange: Required.
11. Clamping Device: Required.
12. Trap-Primer Connection: Required.
13. Trap Material: Cast iron.
14. Trap Pattern: Standard P-trap.

2.04 TRENCH DRAINS

A. Trench Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.6.3 for trench drains.
5. Material: Ductile or gray iron.
6. Flange: Anchor.
7. Clamping Device: Not required.
8. Outlet: Bottom.
9. Grate Material: Stainless steel.
10. Grate Finish: Not required.
11. Dimensions of Frame and Grate:
12. Top Loading Classification: Heavy Duty.
13. Trap Material: Cast iron.
14. Trap Pattern: Standard P-trap.

2.05 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

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

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ayrllett, LLC.
 - b. Durgo, Inc.
 - c. Oatey.
 - d. ProSet Systems Inc.
 - e. RectorSeal.
 - f. Studor, Inc.
 3. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
 4. Housing: Plastic.
 5. Operation: Mechanical sealing diaphragm.
 6. Size: Same as connected fixture or branch vent piping.
- B. Stack Air-Admittance Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durgo, Inc.
 - b. Oatey.
 - c. Studor, Inc.
 3. Standard: ASSE 1050 for vent stacks.
 4. Housing: Plastic.
 5. Operation: Mechanical sealing diaphragm.
 6. Size: Same as connected stack vent or vent stack.
- C. Wall Box:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durgo, Inc.
 - b. Oatey.
 - c. RectorSeal.
 - d. Studor, Inc.
 3. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
 4. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.06 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.

- B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - 1. Open-Top Vent Cap: Without cap.
 - 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.07 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
 - 3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
 - 4. Size: Same as connected soil, waste, or vent stack.
 - 5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - 7. Special Coating: Corrosion resistant on interior of fittings.

2.08 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 - 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 - 2. Size: Same as connected waste piping.
- B. Deep-Seal Traps:
 - 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 - 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch-minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
 - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Air-Gap Fittings:
 - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 - 2. Body: Bronze or cast iron.
 - 3. Inlet: Opening in top of body.
 - 4. Outlet: Larger than inlet.
 - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- H. Frost-Resistant Vent Terminals:
1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
 2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- I. Expansion Joints:
1. Standard: ASME A112.21.2M.
 2. Body: Cast iron with bronze sleeve, packing, and gland.
 3. End Connections: Matching connected piping.
 4. Size: Same as connected soil, waste, or vent piping.

2.09 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
1. General Applications: 12 oz./sq. ft..
 2. Vent Pipe Flashing: 8 oz./sq. ft..
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.

- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 EXECUTION

3.01 CONCRETE BASES

- A. Anchor plumbing equipments to concrete bases.
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
 2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 5. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
 6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.02 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. 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.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
 - H. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.
 - I. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
 - J. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
 - K. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
 - L. Install fixture air-admittance valves on fixture drain piping.
 - M. Install stack air-admittance valves at top of stack vent and vent stack piping.
 - N. Install air-admittance-valve wall boxes recessed in wall.
 - O. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
 - P. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
 - Q. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
 - R. Assemble open drain fittings and install with top of hub 2 inches above floor.
 - S. Install deep-seal traps on floor drains and other waste outlets, if indicated.
 - T. 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.
 - U. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
 - V. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
 - W. Install vent caps on each vent pipe passing through roof.
 - X. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

- Y. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- Z. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- AA. Assemble components of FOG disposal systems and install on floor. Install trap, vent, fresh-air inlet, and flow-control fitting according to authorities having jurisdiction. Install shelf fastened to reinforcement in wall construction and adjacent to unit, unless otherwise indicated. Install culture bottle, culture metering pump, timer, and control on shelf. Install tubing between culture bottle, metering pump, and chamber.
- BB. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 - 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 - 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- CC. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction. Install control panel adjacent to unit, unless otherwise indicated.
- DD. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Division 23 Section "Facility Fuel-Oil Piping."
- EE. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.
- FF. Install wood-blocking reinforcement for wall-mounting-type specialties.
- GG. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- HH. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.03 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
 - D. Secure flashing into sleeve and specialty clamping ring or device.
 - E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
 - F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
 - G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 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. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.05 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.06 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.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain plumbing equipments. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 22 43 00

HEALTHCARE PLUMBING FIXTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following medical plumbing fixtures and related components:
 - 1. Faucets for lavatories showers and sinks.
 - 2. Laminar-flow, faucet-spout outlets.
 - 3. Flushometers.
 - 4. Toilet seats.
 - 5. Protective shielding guards.
 - 6. Fixture supports.
 - 7. Water closets.
 - 8. Lavatories.
 - 9. Clinical sinks.
 - 10. Outlet boxes.
- B. Related Sections include the following:
 - 1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
 - 2. Division 22 Section "Sanitary Waste Piping Specialties" for floor drains.

1.03 DEFINITIONS

- A. Accessible Medical Plumbing Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls the flow of water into or out of the medical plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads, drains and tailpieces, and traps and waste pipes.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.

1.04 SUBMITTALS

- A. Product Data: For each type of medical plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For medical plumbing fixtures to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain medical plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for medical plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Bathtubs: ANSI Z124.1.
 - 3. Plastic Shower Enclosures: ANSI Z124.2.
 - 4. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 5. Vitreous-China Fixtures: ASME A112.19.2M.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 3. Faucets: ASME A112.18.1.
 - 4. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 5. Hose-Coupling Threads: ASME B1.20.7.
 - 6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 7. NSF Materials: NSF 61.
 - 8. Pipe Threads: ASME B1.20.1.
 - 9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 10. Supply Fittings: ASME A112.18.1.
 - 11. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for bathtub and shower faucets:
 - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - 3. Faucets: ASME A112.18.1.
 - 4. Hand-Held Showers: ASSE 1014.
 - 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.

6. Hose-Coupling Threads: ASME B1.20.7.
 7. Manual-Control Antiscald Faucets: ASTM F 444.
 8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
 6. Brass Waste Fittings: ASME A112.18.2.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Grab Bars: ASTM F 446.
 2. Hose-Coupling Threads: ASME B1.20.7.
 3. Off-Floor Fixture Supports: ASME A112.6.1M.
 4. Pipe Threads: ASME B1.20.1.
 5. Plastic Toilet Seats: ANSI Z124.5.
 6. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.06 EXTRA MATERIALS

- 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. See Material Matrix for Quantity.

PART 2 PRODUCTS

2.01 LAVATORY FAUCETS

- A. Lavatory Faucets, See Plumbing Fixture Schedule:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Chicago Faucets.
 - c. Just Manufacturing Company.
 - d. Kohler Co.
 - e. Speakman Company.
 4. Description: Faucet for lavatory-type medical plumbing fixture. Coordinate faucet inlets with supplies, connectors, and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Maximum Flow Rate: 1.5 GM .
 - b. Body Material: Solid brass.

- c. Finish: Polished chrome plate.
- d. Type: Single-control mixing.
- e. Tempering System: Not required.
- f. Supply Centers: Adjustable.
- g. Mounting: Deck, exposed.
- h. Handle(s): Not applicable.
- i. Temperature Indicators: Color-coded for hot and cold water.
- j. Inlet(s): NPS 3/8 tubing, with NPS 1/2 male adaptor.
- k. Spout: Rigid, brass.
- l. Spout Outlet: Laminar flow.
- m. Operation: Compression, manual Noncompression, manual.
- n. Drain: See fixture.

2.02 SINK FAUCETS

- A. Sink Faucets, See Plumbing Fixture Schedule:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Chicago Faucets.
 - c. Just Manufacturing Company.
 - d. Kohler Co.
 - e. Speakman Company.
 - 4. Description: Faucet for sink-type medical plumbing fixtures. Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - b. Body Material: Solid brass.
 - c. Finish: Polished chrome plate.
 - d. Type: Sink faucet.
 - e. Tempering Device: Not required.
 - f. Mixing Valve: Single control.
 - g. Backflow Protection Device for Hose Outlet: Not applicable.
 - h. Supply Centers: 8 inches.
 - i. Mounting: Deck, concealed.
 - j. Handle(s): Not applicable.
 - k. Temperature Indicators: Color-coded for hot water on left and cold water on right.
 - l. Inlet(s): NPS 3/8 plain-end tubing.
 - m. Spout: Rigid, gooseneck, solid Swivel, gooseneck, solid brass with wall brace.
 - n. Spout Outlet: Plain end.
 - o. Vacuum Breaker: Not required.
 - p. Operation: Automatic, hard-wired electric sensor.

2.03 LAMINAR-FLOW FAUCET-SPOUT OUTLETS

- A. Laminar-Flow Faucet-Spout Outlets, See Plumbing Fixture Schedule:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Chronomite Laboratories, Inc.
 - b. NEOPERL, Inc.
4. Description: Chrome-plated-brass faucet-spout outlet that produces non-aerating laminar stream. Include male or female thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.04 FLUSHOMETERS

- A. Flushometers, See Plumbing Fixture Schedule:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Delta Faucet Company.
 - b. Sloan Valve Company.
 - c. Zurn Plumbing Products Group; Commercial Brass Operation.
 4. Description: Flushometer for clinical-sink water-closet-type medical plumbing fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, and copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm operation.
 - b. Style: Exposed.
 - c. Inlet Size: NPS 1.
 - d. Trip Mechanism: Hard-wired, electric-sensor actuator.
 - e. Consumption: 1.6 gal./flush.
 - f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.
 - g. Integral Bedpan Washer: Not required.

2.05 TOILET SEATS

- A. Toilet Seats, See Plumbing Fixture Schedule:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Bemis Manufacturing Company.
 - b. Centoco Manufacturing Corp.
 - c. Church Seats.
 - d. Olsonite Corp.
 - e. Sanderson Plumbing Products, Inc.; Beneke Div.
 4. Description: Plastic toilet seat for water-closet-type medical plumbing fixture.
 - a. Material: Molded, solid plastic with antimicrobial agent.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated, unless otherwise indicated.

- d. Class: Heavy-duty commercial.
- e. Hinge Type: Stainless-steel SC, self-sustaining check.
- f. Color: White.

2.06 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers, See Plumbing Fixture Schedule:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Plumbing Products, Inc.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
 - 3. Description: Manufactured plastic wraps for covering medical 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. 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:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TRUEBRO, Inc.
 - 3. Description: Manufactured plastic enclosure for covering medical plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.07 FIXTURE SUPPORTS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. MIFAB Manufacturing Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- C. Water-Closet Supports, See Plumbing Fixture Schedule:
 - 1. Description: Combination carrier designed for accessible and standard mounting height of wall-mounting, water-closet-type medical plumbing fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

- D. Lavatory Supports:
 - 1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type medical plumbing fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.
- E. Sink Supports:
 - 1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type medical plumbing fixture. Include steel uprights with feet.

2.08 WATER CLOSETS

- A. Floor-Mounting Water Closets, See Plumbing Fixture Schedule:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Eljer.
 - d. Kohler Co.
 - 4. Description Accessible, floor-mounting, floor-outlet, vitreous-china medical plumbing fixture designed for bedpan washing and flushometer valve operation.
 - a. Style: Flushometer valve.
 - 1) Bowl Type: Elongated with siphon-jet design and bedpan lugs or slots. Include bolt caps matching fixture.
 - 2) Height: Accessible.
 - 3) Design Consumption: 1.6 gal./flush.
 - 4) Color: White.
 - b. Flushometer: Top Spud
 - c. Toilet Seat: Open Front
 - d. Bedpan Washer:

2.09 LAVATORIES

- A. Wall-Mounting Lavatories, See Plumbing Fixture Schedule:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C./Fiat Products.
 - d. Eljer.
 - e. Kohler Co.
 - 4. Description: Accessible, wall-mounting, vitreous-china medical plumbing fixture.
 - a. Type: With back.
 - b. Size: 19 by 16 inches rectangular.
 - c. Faucet Hole Punching: Three holes, 4-inch centers.

- d. Faucet Hole Location: Top.
- e. Color: White.
- f. Faucet: Lavatory for separate drain.
- g. Supplies: NPS 3/8 chrome-plated copper tubes or flexible connectors with stops.
- h. Drain: See faucet.
 - 1) Location: Not applicable.
- i. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated, cast-brass P-trap; NPS 1-1/2, 0.032-inch-0.045-inch-thick tubular brass waste to wall; and wall escutcheon.
- j. Protective Shielding Guard(s):
- k. Fixture Support: Lavatory.

B. Counter-Mounting Lavatories:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Briggs Plumbing Products, Inc.
 - c. Crane Plumbing, L.L.C./Fiat Products.
 - d. Eljer.
 - e. Gerber Plumbing Fixtures LLC.
 - f. Kohler Co.
- 4. Description: Accessible, vitreous-china, medical plumbing fixture.
 - a. Type: Self-rimming.
 - b. Rectangular Lavatory Size: 20 by 18 inches.
 - c. Oval Lavatory Size: 19 by 16 inches.
 - d. Round Lavatory Size: 19 inches in diameter.
 - e. Faucet Hole Punching: Three holes, 4-inch centers.
 - f. Faucet Hole Location: Top.
 - g. Color: White.
 - h. Faucet: Lavatory Grip.
 - i. Supplies: NPS 3/8 chrome-plated copper tubes or flexible connectors with stops.
 - j. Drain: Grid.
 - 1) Location: Not applicable.
 - k. Drain Piping: NPS 1-1/4 by NPS 1-1/2 chrome-plated, cast-brass P-trap; NPS 1-1/2, 0.045-inch-thick tubular brass waste to wall; and wall escutcheon.
 - l. Protective Shielding Guard(s):

2.10 CLINICAL SINKS

A. Wall-Mounting Clinical Sinks, See Plumbing Fixture Schedule:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Eljer.

- d. Kohler Co.
- 4. Description: Wall-mounting, back-outlet, vitreous-china, flushing-rim, service-sink-type medical plumbing fixture.
 - a. Size: Approximately 25 by 20 inches.
 - b. Color: White.
 - c. Rim Guard: Stainless steel on front and also on sides if flat rim.
 - d. Faucet: Sink.
 - e. Flushometer:
 - f. Bedpan Washer:
 - g. Fixture Support: Sink.
- B. Floor-Mounting Clinical Sinks:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. American Standard Companies, Inc.
 - b. Crane Plumbing, L.L.C./Fiat Products.
 - c. Eljer.
 - d. Kohler Co.
 - 4. Description: Floor-mounting, bottom-outlet, vitreous-china, flushing-rim, service-sink-type medical plumbing fixture. Include bolt caps.
 - a. Size: Approximately 27 by 20 inches.
 - b. Color: White.
 - c. Rim Guards: Stainless steel on front and sides.
 - d. Sink Base: 10-inch -high, cast terrazzo if required.
 - e. Faucet: Sink.
 - f. Flushometer:
 - g. Bedpan Washer:

2.11 OUTLET BOXES

- A. Dialysis Equipment Outlet Boxes:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Acorn Engineering Company.
 - b. Bradley Corporation.
 - c. Metcraft Industries Inc.
 - d. Whitehall Manufacturing; a division of Acorn Manufacturing Company.
 - 4. Description: Recessed-mounting outlet box with water supply and drain connections.
 - a. Box and Faceplate: Stainless steel.
 - b. Supply Fitting(s): 2 NPS 1/2 PVC ball valve(s) and adapter with male hose-thread outlet.
 - c. Drain: NPS 2 standpipe, P-trap, and direct waste connection to drainage piping.
 - 5. Reinforcement: 2-by-4-inch fire-retardant-treated-wood blocking between studs. Fire-retardant-treated wood blocking is specified in Division 06 Section "Rough Carpentry."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for medical plumbing fixtures to verify actual locations of piping connections before fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Assemble medical plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting 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 back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to domestic water 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, gate, or globe valve if stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install flushometer valves for accessible water closets with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install toilet seats on water closets.
- L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- M. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- N. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
- O. Install escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- P. Set showers in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- Q. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from domestic water piping to medical plumbing fixtures.
- C. Connect drain piping from medical plumbing fixtures to sanitary waste and vent piping.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Verify that installed medical plumbing fixtures are categories and types specified for locations where installed.
- B. Check that medical plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed medical plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.05 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning medical plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets shower valves and flushometer valves to produce proper flow and stream.

- C. Replace washers and seals of leaking and dripping faucets and stops.

3.06 CLEANING

- A. Clean medical plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of medical plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 00 10

MECHANICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The General Conditions and Supplementary Conditions shall apply to and form part of this division.

1.02 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 final connections to systems and equipment.
 - 3. Work specified in Section 23 00 50 and other Division 23 Sections.
- 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.

1.03 DEFINITIONS

- A. Unless otherwise specified, "all clarification form," "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.

1.04 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.

1.05 CODES AND STANDARDS

- A. Work and materials shall be in full accordance with the latest rules and regulations of the Local Fire Marshal; the National Electric Code (NEC); the Uniform Plumbing Code; the California Plumbing Code; California Administrative Code, Title 24, (CAL/OSHA); Local Building Codes; the Uniform Mechanical Code; the California Mechanical Code; 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, provide larger, higher or more restrictive standards without additional costs.

1.06 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. 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 his designated representative.

1.07 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. 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.
- C. 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.
- D. 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. The Contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner.
- E. It is intended that apparatus be located symmetrical with architectural elements. Refer to architectural details in completing the correlating work.
- F. The Contractor shall study drawings and specifications including, and not limited to, architectural, structural, mechanical, plumbing, fire protection, and electrical to determine conflict with ordinances and statutes. 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 cost to the Owner.
- G. Submittal of bid shall indicate the Contractor has examined the site and drawings and has included required allowances in his bid. No allowance shall be made for any error resulting from Contractor's failure to visit job site and to review drawings and specifications. Bid shall include costs for required drawings and changes as outline above, all at no cost to owner.

1.08 RECORD DRAWINGS

- A. 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 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 as to their accuracy.
- D. Record drawings shall be submitted for acceptance and approval to the Architect and Mechanical Engineer before final certificate of acceptance will be issued.

1.09 CUTTING AND PATCHING

- A. Perform all cutting and fitting required for work of this section 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. He 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 nor relieving the Contractor of his responsibilities.

1.12 LOCATIONS

- A. Coordinate in advance of the work, requirements for openings, equipment maintenance clearances, 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.
 - 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 and structural features.

3. Be coordinated with the work of other trades toward the general purpose of having the work progress rapidly and smoothly with a minimum 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 pattern.
6. Be in locations reasonably accessible for hung ceiling areas for maintenance from the floor below. Specifically for equipment, valves, and other items requiring maintenance, adjustment and/or observation.

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 or 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 episodes 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.
- 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 72 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, at no additional cost, any 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. Maximum shutdown during this period of any system shall be 4 hours.

1.15 SUBSTITUTIONS

- A. If substitutions of controls or equipment require any changes in the architectural, structural, mechanical, plumbing or electrical work from that shown on the drawings, the extra cost of the equipment or architectural, structural, mechanical, plumbing or electrical work shall be responsibility of the Contractor requesting the substitution. All substitutions shall be prior 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, 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, provide the 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. Submittals shall include manufacturer's names and model numbers and shall comply with specifications and drawings. The Contractor shall bear the cost of changes necessary to accommodate substitutions if substitution is approved.
- C. The project scope and work is defined in the contract documents. The contractor is responsible for determining the division of work between their subcontractors.
- D. Provide formal submittal to 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. Deviations from 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.
 - 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 or options 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 (3) projects similar to this where such equipment is installed and operating to two (2) or more years.
 - b. Acceptance of substitutions is entirely at the discretion of the Architect.
- E. Formal submittals shall be complete with catalog data and information properly marked to indicate equality of material (where substitution is allowed and desired), 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 Paragraph number (in the upper right-hand side with tabs) for which each submittal is intended. Incomplete submittals shall be rejected.
- F. 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, without additional cost where such compliance is lacking and may be required to be altered in the field.
- G. Submittals shall be bound and shall include, at a minimum, the following:
 - 1. Complete bill of materials listing equipment furnished.

2. Catalog cut sheets of every component being provided (highlighted).
3. Provide completed blue-line shop drawings of the packaged equipment detailing all field connection points.
4. Dimensions, clearance requirements, weights, and capacities.
5. Wiring diagrams showing control interface as applicable.
6. Warranty sheets.
7. Pressure drops as applicable.

- 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 will withdraw approval (if any) of submittals in question.

1.17 SHOP DRAWINGS:

- A. Proceed with preparation of shop drawings immediately upon receiving an authorization to proceed for the project. Shop drawings shall be originally prepared by the contractor. Provide shop drawings in electronic format. Submit prior to material fabrication, order and installation.
- B. Include:
1. Duct and pipe elevations.
 2. Double line ductwork and piping (4" and larger).
 3. Actual size of purchased equipment.
 4. Access panels including ceiling panels.
 5. Access clearances for equipment.
 6. Actual locations of ceiling diffusers/ supply registers and return registers.
 7. Locations of structural penetrations such as beams.
 8. Actual location of control panels and power connections to equipment.
 9. Color coded duct and piping based on material used.
 10. Minimum 1/4" scale drawings.
 11. Label and tag schedule for equipment.
 12. Duct transitions to clear beams or tight areas.
 13. Room temperature sensor locations.
 14. Point of connection to utilities outside the building.
 15. Sections or 3-dimensional drawings of congested areas.
 16. Gridlines.
 17. Utility tunnel plans and sections indicating double line piping, hangers, supports and utilities from other trades.
- C. Coordinate with other trades. Submit a copy to the General Contractor for distribution to other trades, including (but not limited to) controls, electrical, low voltage and fire sprinkler contractor.
- D. Submit a copy to General Contractor for distribution to other trades, including electrical and fire sprinkler contractor.
- E. Submit to commissioning agent for approval to assure design intent is met.
- F. Upon receiving approval from commissioning agent, submit a complete set of shop drawings at one time to the mechanical engineer.

1.18 ELECTRICAL REQUIREMENTS

- A. When electrical work is specified in subsequent sections to be furnished and installed by the Mechanical Contractor, it shall be installed in metallic conduit and in full accordance with the

National Electric Code, the State of California Industrial Accident Commission's Safety Orders and the requirements of Division 26.

- B. The power wiring, safety switches, combination controllers, disconnect switches, motor starters, circuit breakers, motor-control equipment forming part of motor control centers or switchgear assemblies, and the electrical connections of the mechanical equipment to the electrical power source shall be coordinated with and provided under Division 26.
- C. Control Wiring: Low voltage and line voltage conduit and wiring required for controlling mechanical equipment shall be provided under Division 23 of this specification (unless otherwise shown on Electrical Drawings). Installation on these items shall comply with Division 16 requirements. Coordinate with Division 26 for power requirements to mechanical control panels, terminal controllers, etc.

1.19 MOTORS

- A. Before order is placed for electrical devices, the Contractor shall check with the Electrical contractor and verify requirements as to type, mounting voltage and current characteristics as well as to any special delivery instructions.

1.20 TESTS

- A. Contractor shall make tests required by legally constituted authorities and as listed below.
 - 1. Tests shall be made in the presence of the Owner or his representative and a duly authorized inspector. 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. Perform tests after installation and prior to acceptance.
 - 8. 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.
 - 9. 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.
 - 10. 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.
 - 11. Provide necessary provisions and tests for maintaining the operational condition and cleanliness of existing systems.

1.21 LABOR AND MATERIALS

- A. Labor shall be carefully skilled for this kind of work, thorough and first class in all respects and under the direction of a competent foreman.
- B. Materials shall be new, in perfect condition and of domestic manufacturer. Materials for similar uses to be of same type and manufacturer.
- C. Equipment shall bear the manufacturer's label showing performance characteristics. 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.
- E. Unless otherwise specified herein, equipment and fixtures shall be installed in accordance with the manufacturer's recommendations, including recommended service and removal clearances.

1.22 PROTECTION AND CLEAN-UP

- A. Protection: Provide for the safety and good condition of materials and equipment until final acceptance of the Architect. 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 and replace all damaged and defective material, equipment or work precedent to filing application for final acceptance.
- B. Cleaning:
 - 1. Thoroughly clean all parts of the piping, ductwork, fixtures, apparatus and equipment. All parts shall be 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.
 - 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, this Contractor shall be responsible for restoration of same.

1.23 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 shall be provided. Refer to Section 08310, "Access Doors and Frames." Verify all locations with Architect.

1.24 MAINTENANCE, OPERATION INSTRUCTION, ETC.

- 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 four 8-hour periods over consecutive days and shall be 30% classroom and 70% at site location. Coordinate scheduling of instruction times with Owner's operators.
- 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.
 2. Color code schedule.
 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 serviced.
 - d. 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.

1.25 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. A final commissioning report shall be 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, and nameplates specified herein have been approved and properly posted in the building.

1.26 WARRANTY/GUARANTEE

- A. The contractor shall 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 one year (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 nor 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 one year 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.

PART 2 PRODUCTS – NOT APPLICABLE

PART 3 EXECUTION – NOT APPLICABLE

END OF SECTION

SECTION 23 00 50

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 23 Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete base construction requirements.
 - 3. Escutcheons.
 - 4. Joining Materials.
 - 5. Dielectric fittings.
 - 6. Flexible connectors.
 - 7. Mechanical sleeve seals.
 - 8. Equipment nameplate data requirements.
 - 9. Labeling and identifying mechanical systems and equipment is specified in Division 23 Section "Identification for the HVAC Piping and Equipment."
 - 10. Non-shrink grout for equipment installations.
 - 11. Field-fabricated metal and wood equipment supports.
 - 12. Installation requirements common to equipment specification sections.
 - 13. Cutting and patching.
 - 14. Touchup painting and finishing.
- B. Pipe and pipe fitting materials are specified in Division 22 piping system Sections.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.

2. CPVC: Chlorinated polyvinyl chloride plastic.
 3. NP: Nylon plastic.
 4. PE: Polyethylene plastic.
 5. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
1. CR: Chlorosulfonated polyethylene synthetic rubber.
 2. EPDM: Ethylene propylene diene terpolymer rubber.

1.04 SUBMITTALS

- A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
- B. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- C. Coordination Drawings: For access panel and door locations.
- D. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 2. Clearances for installing and maintaining insulation.
 3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 4. Equipment and accessory service connections and support details.
 5. Exterior wall and foundation penetrations.
 6. Fire-rated wall and floor penetrations.
 7. Sizes and location of required concrete pads and bases.
 8. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 9. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 10. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.
- E. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

1.05 QUALITY ASSURANCE

- A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dielectric Unions:
 - a. Epco Sales Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Industries, Inc.; Wilkins Div.
 - 2. Dielectric Flanges:
 - a. Epco Sales Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - 3. Dielectric-Flange Kits:
 - a. Calpico, Inc.
 - b. Central Plastics Co.
 - 4. Dielectric Couplings:

- a. Calpico, Inc.
 - b. Lochinvar Corp.
- 5. Dielectric Nipples:
 - a. Grinnell Corp.; Grinnell Supply Sales Co.
 - b. Victaulic Co. of America.
- 6. Metal, Flexible Connectors:
 - a. Grinnell Corp.; Grinnell Supply Sales Co.
 - b. McWane, Inc.; Tyler Pipe; Gustin-Bacon Div.
 - c. Metraflex Co.
- 7. Mechanical Sleeve Seals:
 - a. Calpico, Inc.
 - b. Metraflex Co.
 - c. Thunderline/Link-Seal.

2.02 PIPE AND PIPE FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. 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 maximum thickness, unless thickness or specific material is 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.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32.
 - 1. Alloy E: Approximately 95 percent tin and 5 percent antimony, lead free.
- F. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements: Manufacturer's standard solvent cements for the following:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- K. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.04 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.05 FLEXIBLE CONNECTORS

- A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
 - 1. 2-Inch NPS and Smaller: Threaded.
 - 2. 2-1/2-Inch NPS and Larger: Flanged.
 - 3. Option for 2-1/2-Inch NPS and Larger: Grooved for use with keyed couplings.
- B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

2.06 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.07 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
 - 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
 - 5. PVC: Manufactured, permanent, with nailing flange for attaching to wooden forms.
 - 6. PVC Pipe: ASTM D 1785, Schedule 40.
 - 7. PE: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
 - 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 - 2. OD: Completely cover opening.
 - 3. Cast Brass: Split casting, with concealed hinge and set screw.
 - a. Finish: Polished chrome-plate.
 - 4. Stamped Steel: One piece, with spring clips and chrome-plated finish.
 - 5. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
 - 6. Cast-Iron Floor Plate: One-piece casting.

2.08 GROUT

- A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psig, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 22 piping Sections specify unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements

were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

- C. Install piping to allow valve servicing.
- D. Install piping at indicated slope.
- E. Install components with pressure rating equal to or greater than system operating pressure.
- F. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- G. Install piping free of sags and bends.
- H. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- I. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- J. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- K. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- L. Install fittings for changes in direction and branch connections.
- M. Install couplings according to manufacturer's written instructions.
- N. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- O. Sleeves are not required for core drilled holes.
- P. Permanent sleeves are not required for holes formed by PE removable sleeves.
- Q. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Build sleeves into walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.

- c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 7 Section "Joint Sealants" for materials.
 - 5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- R. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 - 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- S. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- T. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stopping materials. Refer to Division 7 Section "Firestopping" for materials.
- U. Verify final equipment locations for roughing-in.
- V. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- W. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 - 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 5. 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:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.

- e. 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.
- 6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
- 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
- 8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. ABS Piping: ASTM D 2235 and ASTM D 2661.
 - c. CPVC Piping: ASTM D 2846 and ASTM F 493.
 - d. PVC Pressure Piping: ASTM D 2672.
 - e. PVC Non-pressure Piping: ASTM D 2855.
 - f. PVC to ABS Non-pressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
- 9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- X. Piping Connections: Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 - 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.02 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment giving right of way to piping installed at required slope.

- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.03 PAINTING AND FINISHING

- A. Refer to Division 9 Section "Painting" for paint materials, surface preparation, and application of paint.
- B. Apply paint to exposed piping according to the following, unless otherwise indicated:
 - 1. Interior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 - 2. Interior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 - 3. Interior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
 - 4. Exterior, Ferrous Piping: Use semi-gloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
 - 5. Exterior, Galvanized-Steel Piping: Use semi-gloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
 - 6. Exterior, Ferrous Supports: Use semi-gloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
- C. Paint visible sheet metal behind ceiling inlets and outlets flat black.
- D. Do not paint piping specialties with factory-applied finish.
- E. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.05 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.06 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.07 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.08 GROUTING

- A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. HVAC demolition.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. 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 maximum thickness unless thickness or specific material is 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.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.

- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.

- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.05 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Metraflex Co.
 - c. Pipeline Seal and Insulator, Inc. Linkseal
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Plastic. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.06 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.07 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.08 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.

6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.

- g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
2. Existing Piping: Use the following:
- a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
 - i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to

extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

- 1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. 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.
- F. 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.04 PIPING CONNECTIONS

- A. 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.06 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.08 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.

- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 23 05 19

METERS AND GAGES FOR HVAC PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Light-activated thermometers.
 - 3. Thermowells.
 - 4. Dial-type pressure gages.
 - 5. Gage attachments.
 - 6. Test plugs.
 - 7. Test-plug kits.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Product Certificates: For each type of meter and gage, from manufacturer.
- D. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - a. Terice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Weksler.
 - 3. Standard: ASME B40.200.
 - 4. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
 - 5. Case Form: Adjustable angle unless otherwise indicated.
 - 6. Tube: Glass with magnifying lens and blue organic liquid.
 - 7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 8. Window: Glass or plastic.

9. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
 10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- B. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ernst Flow Industries.
 - b. Marsh Bellofram.
 - c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - d. Weiss Instruments, Inc.
 - e. WIKA Instrument Corporation - USA.
 - f. Weksler.
 2. Standard: ASME B40.200.
 3. Case: Plastic; 7-inch nominal size unless otherwise indicated.
 4. Case Form: Adjustable angle unless otherwise indicated.
 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 7. Window: Glass or plastic.
 8. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.02 LIGHT-ACTIVATED THERMOMETERS

- A. Direct-Mounted, Light-Activated Thermometers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Terice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. WIKA Instrument Corporation - USA.
 - d. Winters Instruments - U.S.
 2. Case: Plastic; 7-inch nominal size unless otherwise indicated.
 3. Scale(s): Deg F.
 4. Case Form: Adjustable angle.
 5. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 6. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 7. Display: Digital.
 8. Accuracy: Plus or minus 2 deg F.

2.03 THERMOWELLS

- A. Thermowells:
1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 3. Material for Use with Copper Tubing: CNR or CUNI.

4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.04 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ernst Flow Industries.
 - b. Marsh Bellofram.
 - c. Terice, H. O. Co.
 - d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - e. Weiss Instruments, Inc.
 - f. WIKA Instrument Corporation - USA.
 2. Standard: ASME B40.100.
 3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 8. Pointer: Dark-colored metal.
 9. Window: Glass or plastic.
 10. Ring: Stainless steel.
 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.05 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.06 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flow Design, Inc.
 2. Peterson Equipment Co., Inc.
 3. Sisco Manufacturing Company, Inc.
 4. Terice, H. O. Co.
- B. Description: Test-station fitting made for insertion into piping tee fitting.

- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: EPDM self-sealing rubber.

2.07 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flow Design, Inc.
 - 2. Peterson Equipment Co., Inc.
 - 3. Sisco Manufacturing Company, Inc.
 - 4. Trerice, H. O. Co.
- B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 100 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

2.08 FLOWMETERS

- A. Vortex-Shedding Flowmeters:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. ABB; Instrumentation and Analytical.
 - b. Eastech Flow Controls.
 - c. EMCO Flow Systems; a division of Spirax Sarco, Inc.
 - d. Emerson Process Management; Rosemount.
 - e. Endress+Hauser.
 - f. ISTECH Corporation.
 - 2. Description: Flowmeter with sensor and indicator.
 - 3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
 - 4. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in gallons per minute.
 - a. Design: Flow obstruction device, vortex-measurement type for liquids.
 - b. Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
 - c. Minimum Pressure Rating: ASME B16.5 (ANSI) CLASS 150.
 - d. Minimum Temperature Rating: 450 deg F.
 - e. Integral Transformer: For low-voltage power operation.

5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
6. Accuracy: Plus or minus 0.25 percent for liquids and percent for gases.
7. Display: Shows rate of flow.
8. Operating Instructions: Include complete instructions with each flowmeter.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- H. Install test plugs in piping tees.
- I. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- J. Install flowmeter elements in accessible positions in piping systems.
- K. Install permanent indicators on walls or brackets in accessible and readable positions.
- L. Install connection fittings in accessible locations for attachment to portable indicators.
- M. Install thermometers in the following locations:
 1. Inlet and outlet of each hydronic zone.
 2. Inlet and outlet of each hydronic boiler.
 3. Two inlets and two outlets of each chiller.
 4. Inlet and outlet of each hydronic coil in air-handling units.
 5. Two inlets and two outlets of each hydronic heat exchanger.
 6. Outside-, return-, supply
- N. Install pressure gages in the following locations:
 1. Inlet and outlet of each boiler water connection.
 2. Suction and discharge of each pump.

3.02 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

3.03 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

A. Thermometers at boiler and water heater inlets and outlets shall be one of the following:

1. Industrial-style, liquid-in-glass type.
2. Direct-mounted, light-activated type.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.05 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F.

3.06 PRESSURE-GAGE SCHEDULE

A. Pressure gages at hot water inlet and outlet of each boiler and water heater shall be the following:

1. Liquid-filled, direct-mounted, metal case.

B. Pressure gages at suction and discharge of each pump shall be one of the following:

1. Liquid-filled, direct-mounted, metal case.

3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

3.08 FLOWMETER SCHEDULE

A. Flowmeters for Heating, Hot-Water Piping: Vortex-shedding type.

END OF SECTION

SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.
 - 2. Iron, single-flange butterfly valves.
 - 3. Bronze Swing check valves.
 - 4. Iron, center-guided check valves.
 - 5. Bronze globe valves.
- B. Related Sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.03 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

1.04 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.05 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B31.9 for building services piping valves.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block 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

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Threaded: With threads according to ASME B1.20.1.
 - 4. Soldered Joint: With according to ASME B16.18.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.03 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bray Controls; a division of Bray International.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Center Line.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum-Bronze
- B. Class 125, Lift Check Valves with Nonmetallic TFE Disc:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. NIBCO INC.
 - b. Crance Co.
 - c. Powell Valves.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 584 alloy C844, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE, or TFE.

2.04 BRONZE SWING CHECK VALVES

- A. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.05 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Metraflex Co.
 - b. NIBCO INC.
 - c. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze

2.06 BRONZE GLOBE VALVES

- A. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. NIBCO INC.
 - c. Milwaukee valve Company.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

PART 3 EXECUTION

3.01 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.

3.02 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 chainwheels on operators for ball butterfly globe and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
 - 2. Lift Check Valves: With stem upright and plumb.

3.03 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.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service except Steam: Globe or angle or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with nonmetallic disc.
 - b. NPS 2-1/2 and Larger: iron, center-guided, resilient-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 125, bronze disc.
 3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 4. Bronze Swing Check Valves: Class 125, bronze disc.
 5. Bronze Gate Valves: Class 125, NRS.
 6. Bronze Globe Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
 3. High-Performance Butterfly Valves: Class 150, single flange.
 4. Iron Swing Check Valves: Class 125, metal seats.
 5. Iron, Center-Guided Check Valves: Class 125, compact-wafer globe, metal seat.
 6. Iron Gate Valves: Class 125, NRS
 7. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 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. Equipment supports.
- B. Related Sections:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- 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.

1.05 SUBMITTALS

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

- 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. Equipment supports.
- C. Delegated-Design Submittal: For 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 trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.
- D. Welding certificates.

1.06 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.

PART 2 PRODUCTS

2.01 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: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 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. Copper Pipe 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.

2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, 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.

2.03 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.

- c. Flex-Strut Inc.
- d. Unistrut Corporation; Tyco International, Ltd.
- 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
- 3. Standard: MFMA-4.
- 4. Channels: Continuous slotted steel channel with intumed lips.
- 5. Channel Nuts: Formed or stamped steel 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.
- 7. Metallic Coating: Electroplated zinc.

2.04 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 - 7. Piping Technology & Products, Inc.
 - 8. Rilco Manufacturing Co., Inc.
 - 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, 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.

2.05 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.07 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, 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 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. 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 Division 07 Section "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 at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- 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.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 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.

3.02 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.

3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M 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.

3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 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: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. 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 not necessary.
 - 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 not necessary.
 - 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.

- J. 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.
- K. 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.
- L. 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.
- M. 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.
- N. 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.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Restraining braces and cables.

1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: D.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: IV.

1.05 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 OSHPD.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: 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 and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - a. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 - b. Preapproval and Evaluation Documentation: By OSHPD, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment 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.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that 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. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. 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.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATOR PADS

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

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Mason Industries.
 - 4. Sausse.
- D. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.

2.02 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. TOLCO Incorporated; a brand of NIBCO INC.
 - 8. Unistrut; Tyco International, Ltd.
 - 9. Sausse.
- D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by OSHPD.
 - 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.
- E. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.
- F. 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.

- G. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- H. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- I. 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.
- J. 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.
- K. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- L. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- M. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.03 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

PART 3 EXECUTION

3.01 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.
- 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.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by OSHPD.
- 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.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. 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 devices using methods approved by OSHPD providing required submittals for component.
- C. 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.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by OSHPD providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. 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.
- H. 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.
- I. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid 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. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.05 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. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.06 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 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.

1.03 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.

1.04 COORDINATION

- 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.

PART 2 PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: White.
 3. Background Color: White.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. 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), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 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: White.
- 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-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.

- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover 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, 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 1-1/2 inches high.

2.04 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. Letter Color: White.
- C. Background Color: Black.
- 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-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.05 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Brass.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.06 VALVE TAGS

- A. 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 minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- 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.

2.07 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: 3 by 5-1/4 inches minimum 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: Yellow background with black lettering.

PART 3 EXECUTION

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
 1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.

- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
 - 1. Heating, Hot-Water Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.04 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Exhaust Air Ducts:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - 2. Supply Air, Return Air and Outside Air:
 - a. Background Color: Blue.
 - b. Letter Color: White
 - 3. Return Air and Outside Air:
 - a. Background Color: Green.
 - 4. Letter Color: White
- 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, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 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: 2 inches, round.
 - 2. Valve-Tag Color:
 - a. Hot Water: Natural.

- 3. Letter Color:
 - a. Hot Water: Black.

3.06 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.

1.03 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. TAB: Testing, adjusting, and balancing.
- C. TABB: Testing, Adjusting, and Balancing Bureau.
- D. TAB Specialist: An entity engaged to perform TAB Work.

1.04 SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. 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.

1.05 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC as a TAB technician.
- B. TAB Conference: Meet with Architect Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect Commissioning Authority.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.06 PROJECT 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.

1.07 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 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 systems for installed 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 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 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.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- J. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. 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.

3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, combination smoke and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 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" and ASHRAE 111 and in this Section.
 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- 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, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Equipment Insulation" And "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.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. 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.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.05 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. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, under final balanced conditions.
 - 5. 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.
 - 6. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. 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 will occur. 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 within specified tolerances.
 - 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 - 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Division 23 Section "Hydronic Pumps."
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.07 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. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.08 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.
 3. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.09 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 weekly 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.

3.10 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.
- 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 contractor.
 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 exhaust-air dampers.
 - b. Fan drive settings including settings and percentage of maximum pitch diameter.
 - c. 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. Balancing stations.
 6. Position of balancing devices.
- E. 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.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 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.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 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.
- F. 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 air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.

3.11 INSPECTIONS

- A. Initial Inspection:
 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
 2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:
 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect and Commissioning Authority.
 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect Commissioning Authority.
 3. Architect Commissioning Authority 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.
 4. 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."
 5. 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.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
 1. 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 contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply.
 - 2. Indoor, exposed supply.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
- B. Related Sections:
 - 1. Division 23 Section "HVAC Equipment Insulation."
 - 2. Division 23 Section "HVAC Piping Insulation."

1.03 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.
- C. Qualification Data: For qualified Installer.
- D. 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.
- E. Field quality-control reports.

1.04 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 E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive,

mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 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.

1.06 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "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.

1.07 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

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor 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 C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.

2.02 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.
- 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges - Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F.
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.

2.04 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 4. Service Temperature Range: 0 to plus 180 deg F.
 5. Color: White.

2.05 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
- d. Mon-Eco Industries, Inc.; 44-05.
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 5. Color: Aluminum.
- 6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 - 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.07 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
 - 1. Adhesive: As recommended by jacket material manufacturer.
 - 2. Color: White Color-code jackets based on system. Color as selected by Architect.
- B. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - 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.

2.08 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.

- c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 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. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 - 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.

2.09 SECUREMENTS

- A. Bands:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 - 2. Aluminum: ASTM B 209, 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 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, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-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. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. C & F Wire.

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 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.

3.04 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 Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

3.05 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 overcompress 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.

3.06 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.

3.07 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.08 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.

3.09 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply.
 2. Indoor, exposed supply.
 3. Indoor, concealed return located in unconditioned space.
 4. Indoor, exposed return located in unconditioned space.
 5. Outdoor, concealed supply and return.
 6. Outdoor, exposed supply and return.
- 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.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- B. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- C. Concealed, rectangular, supply-air duct insulation shall be the following:
 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. 1.5-lb/cu. ft. 3-lb/cu. ft. nominal density.

- D. Concealed, rectangular, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- E. Exposed, round and flat-oval, supply-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- F. Exposed, round and flat-oval, return-air duct insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- G. Exposed, rectangular, return-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Heating hot-water piping, indoors.
- B. Related Sections:
 - 1. Section 23 07 13 "Duct Insulation."

1.03 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 attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.04 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.

1.05 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 E 84, by a testing and inspecting 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. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
 - 1. Piping Mockups:
 - a. One 10-foot section of NPS 2 straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
 - 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 4. Obtain Architect's approval of mockups before starting insulation application.
 - 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed.

1.06 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.

1.07 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "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.
- C. Coordinate installation and testing of heat tracing.

1.08 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

2.01 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 in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Industrial Insulation Group, LLC (IIG-LLC).
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Pittsburgh Corning Corporation.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.

7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.

Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- J. Mineral-Fiber, Preformed Pipe Insulation:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Owens Corning.
 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.

Phenolic:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kingspan Tarec Industrial Insulation NV.
 - b. Resolco International BV.
2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ramco Insulation, Inc.

2.03 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.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Mon-Eco Industries, Inc.
 - d. Vimasco Corporation.
- C. 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. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Foster Brand; H. B. Fuller Construction Products.
- D. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
- E. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.
- F. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.
- G. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.
- H. 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.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.
- I. PVC Jacket Adhesive: Compatible with PVC jacket.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Knauf Insulation.
 - c. Vimasco Corporation.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.

3. Service Temperature Range: 0 to 180 deg F.
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 - d. Mon-Eco Industries, Inc.
 - e. Vimasco Corporation.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Vimasco Corporation.
- Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
 4. Color: White.

2.06 SEALANTS

- A. Cellular-Glass, Phenolic, and Polyisocyanurate Joint Sealants:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Mon-Eco Industries, Inc.
 - d. Pittsburgh Corning Corporation.

FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, PVDC, and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.07 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 5. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) ITW Insulation Systems; Illinois Tool Works, Inc.
 6. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) ITW Insulation Systems; Illinois Tool Works, Inc.
 7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) ITW Insulation Systems; Illinois Tool Works, Inc.
 8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.08 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.
 - d. Speedline Corporation.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: Color-code jackets based on system. 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.
- D. Metal Jacket:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. ITW Insulation Systems; Illinois Tool Works, Inc.
 - c. RPR Products, Inc.
 - 2. Aluminum Jacket: Comply with ASTM B 209, 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: 1-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 2-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.
 - f.

PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

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

- a. ITW Insulation Systems; Illinois Tool Works, Inc.

2.09 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 - 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. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc., an American Biltrite Company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Compac Corporation.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Venture Tape.
 - 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.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Compac Corporation.

- c. Ideal Tape Co., Inc., an American Biltrite Company.
 - 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.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - 2. Width: 3 inches.
 - 3. Film Thickness: 4 mils.
 - 4. Adhesive Thickness: 1.5 mils.
 - 5. Elongation at Break: 145 percent.
 - 6. Tensile Strength: 55 lbf/inch in width.
- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - 2. Width: 3 inches.
 - 3. Film Thickness: 6 mils.
 - 4. Adhesive Thickness: 1.5 mils.
 - 5. Elongation at Break: 145 percent.
 - 6. Tensile Strength: 55 lbf/inch in width.

2.10 SECUREMENTS

- A. Bands:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
- Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 3/4 inch wide with.
- 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with.
 - 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. C & F Wire.

PART 3 EXECUTION

3.01 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.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: 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 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 trade 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.

3.03 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 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 application and finishing.
- 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 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.
 - 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, 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 pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 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 similar 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. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.04 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 Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall 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 wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. 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 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. 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 07 84 13 "Penetration Firestopping."

3.05 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, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as 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 or sectional pipe insulation of same material and thickness as 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 or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe

insulation by not less than two 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 or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 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.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- 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 adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two 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.

3.06 INSTALLATION OF CALCIUM SILICATE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
 - 2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
 - 3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- 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 block insulation of same material and thickness as pipe insulation.
 - 4. Finish flange insulation same as pipe insulation.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
 - 3. Finish fittings insulation same as pipe insulation.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 2. Install insulation to flanges as specified for flange insulation application.
 - 3. Finish valve and specialty insulation same as pipe insulation.

3.07 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 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 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.

3.08 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 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 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.

3.09 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 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 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.

3.10 INSTALLATION OF PHENOLIC INSULATION

- A. General Installation Requirements:
1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
- B. 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 with vapor retarders 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.

- C. 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 block insulation of same material and thickness as pipe insulation.
- D. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- E. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
 - 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.

3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. 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.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. 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.
- E. Where PVDC jackets are indicated, install as follows:
 - 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 - 2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate

overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.

3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.12 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 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 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.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 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. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
 - 1. NPS 12 and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.
 - b. Phenolic: 2 inches thick.
 - 2. NPS 14 and Larger: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.
 - b. Phenolic: 2 inches thick.

3.16 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. Piping, Concealed:
 - 1. None.
 - 2. PVC, Color-Coded by System: 30 mils thick.
- C. Piping, Exposed:
 - 1. None.
 - 2. PVC, Color-Coded by System: 30 mils thick.

END OF SECTION

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 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.
- B. Related Sections include the following:
 - 1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
 - 2. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
 - 3. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.03 DEFINITIONS

- A. Retain abbreviations and terms that remain after this Section has been edited.
- B. DDC: Direct digital control.
- C. I/O: Input/output.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.04 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh: 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:
 - a. Water Temperature: Plus or minus 1 deg F.
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1 deg F.
 - e. Temperature Differential: Plus or minus 0.25 deg F.
 - f. Carbon Dioxide: Plus or minus 50 ppm.
 - g. Electrical: Plus or minus 5 percent of reading.

1.05 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 1. Retain three subparagraphs below for DDC systems.
 2. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 3. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 4. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. 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. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 3. Wiring Diagrams: Power, signal, and 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 size, leakage, and flow characteristics.
 7. Schedule of valves including flow characteristics.
 8. DDC System Hardware:
 - a. Schematic diagrams and floor plans for field sensors and control hardware.
 - b. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 10. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.

- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- D. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with BACNet.
- E. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.
- F. Samples for Verification: For each color required, of each type of thermostat or sensor cover.
- G. 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.
- H. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- I. Field quality-control test reports.
- J. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. 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.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

1.07 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 equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.08 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 28 Section "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.
- C. Coordinate equipment with Division 28 Section "Access Control" to achieve compatibility with equipment that interfaces with that system.
- D. Coordinate equipment with Division 27 Section "Clock Systems" to achieve compatibility with equipment that interfaces with that system.
- E. Coordinate equipment with Division 28 Section "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.
- F. Coordinate equipment with Division 26 Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
- G. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.
- H. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- I. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
- J. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- K. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.
- L. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 CONTROL SYSTEM

- A. Manufacturers:
 - 1. Siemens
 - 2. Alertron through Climatec

- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- C. Control system shall include the following:

2.03 DDC EQUIPMENT

- A. Operator Workstation: One PC-based microcomputer(s) with minimum configuration as follows:
 - 1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
 - 2. Processor: Intel Pentium 4, 3.8 GHz.
 - 3. Random-Access Memory: 2 GB.
 - 4. Graphics: Video adapter, minimum 1280 x 1024 pixels, 64-MB video memory, with TV out.
 - 5. Monitor: 17 inches, LCD color.
 - 6. Keyboard: QWERTY, 105 keys in ergonomic shape.
 - 7. Floppy-Disk Drive: 1.44 MB.
 - 8. Hard-Disk Drive: 80 GB.
 - 9. CD-ROM Read/Write Drive: 48x24x48.
 - 10. Mouse: Three button, optical.
 - 11. Uninterruptible Power Supply: 2 kVa.
 - 12. Operating System: Microsoft Windows XP Professional with high-speed Internet access.
 - a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
 - b. BACNet Compliance: System shall be capable of BACNet communication according to ANSI/ASHRAE 135-2004.
 - c. Print Head: 4800 x 1200 dpi optimized color resolution.
 - d. Paper Handling: Minimum of 100 sheets.
 - e. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.
 - 13. Application Software:
 - a. I/O capability from operator station.
 - b. System security for each operator via software password and access levels.
 - c. Automatic system diagnostics; monitor system and report failures.
 - d. Database creation and support.
 - e. Automatic and manual database save and restore.
 - f. Dynamic color graphic displays with up to 10 screen displays at once.
 - g. Custom graphics generation and graphics library of HVAC equipment and symbols.
 - h. Alarm processing, messages, and reactions.
 - i. Trend logs retrievable in spreadsheets and database programs.
 - j. Alarm and event processing.
 - k. Object and property status and control.
 - l. Automatic restart of field equipment on restoration of power.
 - m. Data collection, reports, and logs. Include standard reports for the following:
 - 1) Current values of all objects.
 - 2) Current alarm summary.
 - 3) Disabled objects.
 - 4) Alarm lockout objects.
 - 5) Logs.
 - n. Custom report development.

- o. Utility and weather reports.
- p. Workstation application editors for controllers and schedules.
- q. Maintenance management.
- 14. Custom Application Software:
 - a. English language oriented.
 - b. Full-screen character editor/programming environment.
 - c. Allow development of independently executing program modules with debugging/simulation capability.
 - d. Support conditional statements.
 - e. Support floating-point arithmetic with mathematic functions.
 - f. Contains predefined time variables.
- B. Diagnostic Terminal Unit: Portable notebook-style, PC-based microcomputer terminal capable of accessing system data by connecting to system network with minimum configuration as follows:
 - 1. System: With one integrated USB 2.0 port, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
 - 2. Processor: Intel Pentium 4, 2 GHz.
 - 3. Random-Access Memory: 1 GHz.
 - 4. Graphics: Video adapter, minimum 1024 x 768 pixels, 64-MB video memory.
 - 5. Monitor: 17 inches, LCD color.
 - 6. Keyboard: QWERTY 105 keys in ergonomic shape.
 - 7. Floppy-Disk Drive: 1.44 MB.
 - 8. Hard-Disk Drive: 20 GB.
 - 9. CD-ROM Read/Write Drive: 48x24x48.
 - 10. Pointing Device: Touch pad or other internal device.
- C. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 - 3. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
 - b. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
 - c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - d. Remote communications.
 - e. Maintenance management.
 - f. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- D. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- E. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
 8. F. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
 9. Output ripple of 5.0 mV maximum peak to peak.
 10. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 11. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.04 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 - 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
 - 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
 - 4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.
 - 5. Enclosure: Waterproof rated for operation at 40 to 150 deg F.

2.05 ALARM PANELS

- A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate 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. Provide common keying for all panels.
- B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.
 - 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.

2.06 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
 - 1. Manufacturers:
 - a. Siemens.
 - b. ACI Automation Components
 - c. Building Automation Products (BAPI)
 - 2. Accuracy: Plus or minus 0.5 deg F at calibration point.
 - 3. Wire: Twisted, shielded-pair cable.
 - 4. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 - 5. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Exposed.
 - b. Set-Point Indication: Exposed.
 - c. Thermometer: Concealed.
 - d. Color:
 - 1) Orientation: Vertical or Horizontal.
- C. RTDs and Transmitters:
 - 1. Manufacturers:

- a. Siemens.
 - b. ACI Automation Components
 - c. Building Automation Products (BAP)
- 2. Accuracy: Plus or minus 0.2 percent at calibration point.
- 3. Wire: Twisted, shielded-pair cable.
- 4. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
- 5. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Exposed.
 - b. Set-Point Indication: Keyed Exposed.
 - c. Thermometer: Concealed.
 - d. Color:
 - e. Orientation: Vertical or Horizontal.
- D. Pressure Transmitters/Transducers:
 - 1. Manufacturers:
 - a. Setra.
 - b. General Eastern Instruments.
 - c. MAMAC Systems, Inc.
 - d. ROTRONIC Instrument Corp.
 - e. TCS/Basys Controls.
 - f. Vaisala.
 - 2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
 - 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
 - 4. Differential-Pressure Switch (Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
 - 5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.
- E. Room Sensor Cover Construction: Manufacturer's standard locking covers.
- F. Room sensor accessories include the following:
 - 1. Insulating Bases: For sensors located on exterior walls.

2.07 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
 - 1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. I.T.M. Instruments Inc.

2.08 THERMOSTATS

- A. Manufacturers:
- B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.
 - 1. Label switches "FAN ON-OFF".
 - 2. Mount on single electric switch box.
- C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set up for four separate temperatures per day.
 - 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
 - 5. Short-cycle protection.
 - 6. Programming based on every day of week.
 - 7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
 - 8. Battery replacement without program loss.
 - 9. Thermostat display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 - 1. Selector Switch: Integral, manual on-off-auto.
- F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
 - 1. Bulbs in water lines with separate wells of same material as bulb.

2. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 3. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 4. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- G. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- H. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.09 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 4. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
 - a. Belimo Aircontrols (USA), Inc.
 - b. Siemens
 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 3. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 4. Coupling: V-bolt and V-shaped, toothed cradle.
 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 7. Power Requirements (Two-Position Spring Return): 24-V ac.
 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 10. Temperature Rating: Minus 22 to plus 122 deg F.
 11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
 12. Run Time: 12 seconds open, 5 seconds closed.

2.10 CONTROL VALVES

- A. Manufacturers:
1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
 2. Siemens.
 3. Hayward Industrial Products, Inc.

4. Magnatrol Valve Corporation.
 5. Neles-Jamesbury.
 6. Bray.
- B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- C. Hydronic system globe valves for modulating flow control applications shall have the following characteristics:
1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
 4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 5. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- D. Butterfly Valves for two position, non-modulating applications shall be 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Lug.
 2. Disc Type: Nickel-plated ductile iron.
 3. Sizing: 1-psig maximum pressure drop at design flow rate.

2.11 COMMUNICATION AND CONTROL WIRING

- A. Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 16 unless otherwise noted herein.
- B. All insulated wire to be copper conductors, UL labeled for 90°C minimum service.
- C. Wire Sizing and Insulation
- D. Wiring shall comply with minimum wire size and insulation based on services listed below:
- | | | |
|------------|----------------------|------------------|
| 1. Service | Minimum Gage/Type | Insulation Class |
| 2. Class 1 | 12 - 14 AWG Stranded | 600 Volt |
| 3. Class 2 | 18 - 22 AWG Stranded | 300 Volt |
| 4. Class 3 | 18 AWG Stranded | 300 Volt |
5. Provide plenum-rated cable when open cable is permitted in supply or return air plenum and where allowed per execution specifications
- E. Control Wiring:
1. Digital output shall use Class 1 or Class 2, twisted pair not required, per local codes.
 2. Low voltage digital input shall use Class 2 twisted pair, insulated.

3. Low voltage analog input shall use Class 2 twisted pair, insulated and shielded where required.
 4. Low voltage analog output shall use Class 2 twisted pair, insulated and shielded where required.
 5. Actuators with tri-state control shall use 3 conductor with same characteristics.
- F. Communication Wiring
1. MLN Ethernet Cable shall be minimum CAT 5e or better.
 2. ALN, FLN, and TX-I/O IBE shall be 24 AWG, TSP, 12.5 pf/ft or less low capacitance cable, 4 twists per foot minimum.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.02 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats and other exposed control sensors with drawings and room details before installation.
- D. Install guards on thermostats in the following locations:
 1. Where indicated.
- E. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- I. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

3.03 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- C. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- D. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.04 CONTROL WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes and Division 26 of this specification. Where the requirements of this section differ from those in Division 26, the requirements of this section shall take precedence.
- B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved conduit according to NEC and Division 26 requirements.
- C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub fused when required to meet Class 2 current limit.)
- D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in conduit may be used provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.
- E. All wiring in mechanical, electrical, or service rooms—or where subject to damage— shall be installed in conduit.
- F. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- G. Do not install wiring in conduit containing tubing.
- H. Where plenum rated cable is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft) intervals.
- I. Where plenum rated cable is used without conduit, it shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to electrical conduits, piping, or ceiling suspension systems.
- J. All wire-to-device connections shall be made at a terminal block or wire nut. All wire-to-wire connections shall be at a terminal strip or wire nut.
- K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- L. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers or interposing relays.
- M. All plenum rated wiring shall be installed as continuous lengths, with no splices permitted between termination points.
- N. All wiring in conduit shall be installed as continuous lengths, with no splices permitted between termination points or junction boxes.

- O. Maintain fire rating at all penetrations. Install plenum wiring in sleeves where it passes through walls and floors.
- P. Size and type of conduit and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
- Q. Control and status relays are to be located in designated enclosures only. These enclosures can include packaged equipment control panel enclosures.
- R. Conceal all conduit, except within mechanical, electrical, or service rooms. Install conduit to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).
- S. Secure conduit with conduit clamps fastened to the structure and spaced according to code requirements. Conduit and pull boxes may not be hung on flexible duct strap or tie rods. Conduits may not be run on or attached to ductwork.
- T. Adhere to this specification's Division 26 requirements where conduit crosses building expansion joints.
- U. The Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- V. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 1 m (3 ft) in length and shall be supported at each end. Flexible metal conduit less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.
- W. Conduit must be adequately supported, properly reamed at both ends, and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.05 COMMUNICATION WIRING

- A. The contractor shall adhere to the items listed in the "Wiring" article in Part 2 of the specification.
- B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- C. Do not install communication wiring in raceway and enclosures containing Class 1.
- D. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
- F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.

- G. All runs of communication wiring shall be unspliced length when that length is commercially available.
- H. All communication wiring shall be labeled in accordance with the HVAC Control System control drawing submittal package instructions or to indicate origination and destination data at a minimum.

3.06 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check instrument tubing for proper fittings, slope, material, and support.
 - 5. Check installation of air supply for each instrument.
 - 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 - 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 8. Check temperature instruments and material and length of sensing elements.
 - 9. Check control valves. Verify that they are in correct direction.
 - 10. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.07 ADJUSTING

- A. Calibrating and Adjusting:
 - 1. Calibrate instruments.
 - 2. Make three-point calibration test for both linearity and accuracy for each analog instrument.

3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliamper meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
7. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
8. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
9. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
10. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
11. Provide diagnostic and test instruments for calibration and adjustment of system.
12. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature set points.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 23 09 70

DIRECT DIGITAL CONTROL (DDC) SYSTEM COMMISSIONING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Provide the following:
 - 1. DDCS and equipment testing and start-up
 - 2. Validation of proper and thorough installation of DDCS and equipment
 - 3. Functional testing of control systems
 - 4. Demonstration testing of control systems
 - 5. Documentation of tests, procedures, and installations
 - 6. Coordination of DDCS training
 - 7. Documentation of DDCS Operation and Maintenance materials
- B. For general DDC System requirements, refer to Section 23 09 00 Instrumentation and Control for HVAC.

1.02 COORDINATION

- A. Assist Owner's Commissioning Authority/Coordinator in Commissioning, including attending commissioning meetings.
- B. Testing Adjusting & Balancing
 - 1. Coordinate with TAB contractors in test and balance work as specified in Section 23 05 93 Testing Adjusting & Balancing. A significant number of balancing procedures require the DDCS to be operational and require Contractor time to assist the TAB contractor in their work.
 - 2. Assist the TAB contractor in determining pump differential pressure setpoints.
- C. Coordinate with Division 23 contractors in the performance of pre-functional and functional tests as specified in Section 23 09 95 Mechanical Commissioning.

1.03 SEQUENCING

- A. The following list outlines the general sequence of events for submittals and commissioning:
 - 1. Submit Hardware and Shop Drawings and receive approval.
 - 2. Initiate installation of DDCS hardware, devices and wiring.
 - 3. Develop point database and application software.
 - 4. Simulate sequencing and debug programming off-line to the extent practical.
 - 5. Submit Programming and Graphics no less than 30 days before software is to be installed in field devices and receive approval.
 - 6. Complete installation of DDCS hardware, devices and wiring.
 - 7. Install point database and application software in field panels.
 - 8. Submit Functional Tests no less than 30 days prior to conducting tests and receive approval.
 - 9. Perform DDCS Pre-functional Tests (start up, calibration and tuning) and submit Pre-functional Tests for approval.
 - 10. Field test application programs prior to functional testing.
 - 11. Receive DDCS Pre-functional Test Report approval and approval to schedule Functional Tests.

12. Perform and record functional tests and submit Functional Test Report for approval.
 - a. Some tests may not be possible due to weather conditions. These tests may be deferred to post-occupancy period on approval from the Commissioning Authority.
13. Assist TAB contractor in TAB tests and determining setpoints as specified in Sections 230593 Testing Adjusting & Balancing and 230995 Mechanical Systems Commissioning.
14. Submit Training Materials and receive approval.
15. Receive DDCS Functional Test Report approval and approval to schedule Demonstration Tests.
16. Perform Demonstration Tests to Commissioning Authority and submit Demonstration Test Report.
17. Receive acceptance of Demonstration Tests.
18. Train Owner personnel on DDCS operation and maintenance.
19. Substantial Completion.
20. Prepare and initiate commissioning Trend Logs.
21. Submit Trend Logs in format specified for review and approval.
22. Receive approval of successful Trend Log tests, or retest as required.
23. Complete all items in Completion Requirements per Paragraph 1.6.
24. Provide administration level password access to the Owner.
25. Final Acceptance.
26. Begin Warranty Period.

1.04 SUBMITTALS

- A. For shop drawing and other submittals, refer to Section 23 09 00 Direct Digital Control Systems and Section 23 09 01 DDC Server and User Interface.

1.05 FUNCTIONAL TEST DOCUMENTATION

- A. Pre-functional Tests
 1. Prepare forms to document the proper startup of the DDCS.
 2. All equipment shall be included on the test forms including but not limited to:
 - a. Digital outputs: proper installation, normal position, response to command at control unit (CU)
 - b. Digital inputs: proper installation, device test, response at CU
 - c. Analog outputs: proper installation of devices, verification of maximum and minimum stroke
 - d. Analog inputs: proper installation of sensors, calibration
 - e. Wiring connections and other electrical issues
 - f. Panels: confirmation of location, power source (electrical circuit used), confirmation of emergency power where specified
 - g. Alarms and safeties: verification of alarm routing to all specified devices and correct hierarchy. Example: confirm alarm routing to cell phones, email, servers, remote workstations. Confirm that appropriate alarm levels are routed to appropriate devices.
 - h. Loop tuning: document setting of P/I parameters for all loops, chosen setpoints, time delays, loop execution speed.
 - i. Network traffic: document speed of screen generation, alarm and signal propagation in system with all required commissioning trends active.
 3. Each form shall have a header or footer where the technician performing the test can indicate his/her name and the date of the test.
 4. Submit forms for approval.
 5. Complete work, document results on forms, and submit for approval as Pre-Functional Test Report.

B. Functional Tests

1. Commissioning Authority will prepare functional testing forms after Programming and Graphics Submittal has been reviewed and approved. Tests will be designed to test all sequences in a formal manner with simulations and expected outcomes.
2. DDCS Contractor will review tests and recommend changes that will improve ease of testing or avoid possible system damage, etc.
3. DDCS Contractor will complete tests and document on forms in electronic format. Each form shall have a header or footer where the technician performing the test can indicate his/her name and the date of the test.
4. Submit forms for approval as Functional Test Report.

1.06 COMPLETION REQUIREMENTS

A. Procedure

1. Until the documents required in this section are submitted and approved, the system will not be considered "accepted" and final payment to DDCS Contractor will not be made.
2. Before requesting acceptance of work, submit one set of completion documents for review and approval of Owner.
3. After review, furnish quantity of sets indicated below to Owner.

B. Completion Documents

1. Owner's Manuals. See Section 23 09 00 Instrumentation and Control for HVAC.
2. English language control sequences updated to reflect final programming installed in the DDCS at the time of system acceptance.
3. Complete original issue diskettes/CDs for all software provided, including operating systems, programming language, operator workstation software, and graphics software.
4. Complete CD copy of DDCS database, user screens, setpoints and all configuration settings necessary to allow re-installation of system after crash or replacement of server, and resume operations with the DDCS in the same configuration as during Owner sign-off.
5. Project Record Drawings. "As-built" versions of the submittal drawings in reproducible format.
6. Commissioning Reports. Completed versions of all Pre-functional and Functional Test reports, calibration logs, etc., per paragraph 1.5.
7. Copy of inspection certificates provided by the local code authorities.
8. Written guarantee and warranty documents for all equipment and systems, including the start and end date for each.
9. Training materials as required by 3.6E.
10. Contact information. Names, addresses, and 24-hour telephone numbers of contractors installing equipment, and the control systems and service representatives of each.

PART 2 PRODUCTS

2.01 INSTRUMENTATION

- A. Instrumentation required to verify readings, calibrate sensors, and test the system and equipment performance shall be provided by Contractor.

PART 3 EXECUTION

3.01 PRE-FUNCTIONAL TESTS

- A. General
 - 1. Check installed products before continuity tests, leak tests and calibration.
 - 2. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them and that the devices are accessible.
 - 3. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
 - 4. Verify integrity/safety of all electrical connections.
 - 5. Verify that shielded cables are grounded only at one end.
 - 6. Verify that all sensor locations are as indicated on drawings and are away from causes of erratic operation.
 - 7. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
- B. Digital Outputs
 - 1. Verify that all digital output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
- C. Digital Inputs
 - 1. Adjust setpoints, where applicable.
 - a. For current switches used as status on fans, adjust current setpoint so that fan status is "off" when fan discharge damper (if present) is fully closed and when belt is broken (temporarily remove belt).
 - b. For current switches used as status on pumps, adjust current setpoint so that pump status is "off" when pump is dead-headed (temporarily close discharge valve).
 - c. For differential pressure sensors on pumps and fans, set so that status is on when pump operating with all valves open (out on its curve).
- D. Analog Outputs
 - 1. Verify start and span are correct and control action is correct.
 - 2. Check all control valves and automatic dampers to ensure proper action and closure.
 - 3. Make any necessary adjustments to valve stem and damper blade travel.
 - 4. Check all normal positions of actuators with spring return.
 - 5. For outputs to reset other manufacturer's devices (for example, chiller setpoint) and for feedback from them, calibrate ranges to establish proper parameters.
- E. Control Valve Checkout:
 - 1. Verify that control valves are installed correctly for flow direction.
 - 2. Verify that valve body attachment is properly secured and sealed.
 - 3. Verify that valve actuator and linkage attachment is secure.
 - 4. Verify that actuator wiring is complete, enclosed and connected to correct power source.
 - 5. Verify that valve ball, disc or plug travel is unobstructed.
 - 6. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.
- F. Instrument Checkout:
 - 1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
 - 2. Verify that attachment is properly secured and sealed.
 - 3. Verify that conduit connections are properly secured and sealed.

4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:
 - a. Verify sensing element type and proper material.
 - b. Verify length and insertion.

G. Alarms and Interlocks

1. A log shall be kept and initialed by the technician showing date and time, alarm/interlock description, action taken to initiate the alarm/interlock, and resulting action, and included in the Pre-functional Test Report.
2. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
3. Coordinate with Division 26 to test fire and life safety systems alarm contacts.
4. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
5. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

H. Analog Input Calibration

I. Variable Frequency Drive Minimum Speed

1. Minimum speed for VFD-driven equipment shall be determined in accordance with manufacturer recommended low speed limit settings.

J. Tuning

1. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the Pre-functional Test Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):

| Controlled Variable | Control Accuracy |
|--------------------------------|----------------------------|
| Airflow and waterflow | ±10% |
| Heating, hot Water Temperature | ±1°F |
| Duct Temperature | ±2°F |
| Water Differential Pressure | ±1.5 psi |
| Others | ±2 times reported accuracy |

K. Interface and Control Panels

1. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
2. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.
3. Check power supplies for proper voltage ranges and loading.
4. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.

5. Check for adequate signal strength on communication networks.
 6. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
 7. Ensure that buffered and/or volatile information is held through power outage.
 8. With all system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
 9. Check for adequate grounding of all DDC panels and devices.
- L. Operator Interfaces
1. Verify that all elements on the graphics are functional and are properly bound to physical devices and/or virtual points, and that hot links or page jumps are functional and logical.
 2. Verify that the alarm printing, logging, paging, emailing etc. is functional and per requirements.

3.02 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION

- A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
- B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
- C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
- D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.
- E. Provide diagnostic and test equipment for calibration and adjustment.
- F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
- G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
- H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
- I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.
- J. Analog Signals:
 1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
 2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
 3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

4. The calibrating parameters in software (e.g. slope and intercept) shall be adjusted as required. A calibration log shall be kept and initialed by the technician showing date and time, sensor and hand-held readings, and calibration constant adjustments and included in the Pre-functional Test Report.
 5. Inaccurate sensors must be replaced if calibration is not possible.
- K. Digital Signals:
1. Check digital signals using a jumper wire.
 2. Check digital signals using an ohmmeter to test for contact making or breaking.
- L. Control Valves:
1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
 2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
 3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
 4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
- M. Meters: Check sensors at zero, 50, and 100 percent of Project design values.
- N. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.
- O. Switches: Calibrate switches to make or break contact at set points indicated.
- P. Transmitters:
1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
 2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.
- Q. Pressure:
1. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 2. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
- R. Temperature:
1. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 2. Calibrate temperature switches to make or break contacts.
 3. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 4. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 5. Provide diagnostic and test instruments for calibration and adjustment of system.
 6. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- S. Adjust initial temperature and humidity set points.

- T. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose

3.03 DDC SYSTEM CONTROLLER CHECKOUT

- A. Verify power supply.
 - 1. Verify voltage, phase and hertz.
 - 2. Verify that protection from power surges is installed and functioning.
 - 3. Verify that ground fault protection is installed.
 - 4. If applicable, verify if connected to UPS unit.
 - 5. If applicable, verify if connected to a backup power source.
 - 6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.
- B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.
- C. Verify that spare I/O capacity is provided.

3.04 DDC CONTROLLER I/O CONTROL LOOP TESTS

- A. Testing:
 - 1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
 - 2. Test every I/O point throughout its full operating range.
 - 3. Test every control loop to verify operation is stable and accurate.
 - 4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
 - 5. Test and adjust every control loop for proper operation according to sequence of operation.
 - 6. Test software and hardware interlocks for proper operation. Correct deficiencies.
 - 7. Operate each analog point at the following:
 - a. Upper quarter of range.
 - b. Lower quarter of range.
 - c. At midpoint of range.
 - 8. Exercise each binary point.
 - 9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
 - 10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desired results.

3.05 DDC SYSTEM VALIDATION TESTS

- A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.
- B. After approval of Test Plan, execute all tests and procedures indicated in plan.

- C. After testing is complete, submit completed test checklist.
- D. Pretest Checklist: Submit the following list with items checked off once verified:
1. Detailed explanation for any items that are not completed or verified.
 2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
 3. HVAC equipment motors operate below full-load amperage ratings.
 4. Required DDC system components, wiring, and accessories are installed.
 5. Installed DDC system architecture matches approved Drawings.
 6. Control electric power circuits operate at proper voltage and are free from faults.
 7. Required surge protection is installed.
 8. DDC system network communications function properly, including uploading and downloading programming changes.
 9. Using BACnet protocol analyzer, verify that communications are error free.
 10. Each controller's programming is backed up.
 11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
 12. All I/O points are programmed into controllers.
 13. Testing, adjusting and balancing work affecting controls is complete.
 14. Dampers and actuators zero and span adjustments are set properly.
 15. Each control damper and actuator goes to failed position on loss of power.
 16. Valves and actuators zero and span adjustments are set properly.
 17. Each control valve and actuator goes to failed position on loss of power.
 18. Meter, sensor and transmitter readings are accurate and calibrated.
 19. Control loops are tuned for smooth and stable operation.
 20. View trend data where applicable.
 21. Each controller works properly in standalone mode.
 22. Safety controls and devices function properly.
 23. Interfaces with fire-alarm system function properly.
 24. Electrical interlocks function properly.
 25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
 26. Record Drawings are completed.
 27. Test Plan:
 28. Prepare and submit a validation test plan including test procedures for performance validation tests.
 29. Test plan shall address all specified functions of DDC system and sequences of operation.
 30. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
 31. Explain method for simulating necessary conditions of operation used to demonstrate performance.
 32. Include a test checklist to be used to check and initial that each test has been successfully completed.
 33. Submit test plan documentation 30 business days before start of tests.
 34. Validation Test:
 35. Verify operating performance of each I/O point in DDC system.
 36. Verify analog I/O points at operating value.
 37. Make adjustments to out-of-tolerance I/O points.
 38. Identify I/O points for future reference.
 39. Simulate abnormal conditions to demonstrate proper function of safety devices.
 40. Replace instruments and controllers that cannot maintain performance indicated after adjustments.
 41. Simulate conditions to demonstrate proper sequence of control.

42. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
43. After 24 Hours following Initial Validation Test:
44. Re-check I/O points that required corrections during initial test.
45. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.
46. After 24 Hours of Second Validation Test:
47. Re-check I/O points that required corrections during second test.
48. Continue validation testing until I/O point is normal on two consecutive tests.
49. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
50. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.
51. DDC System Response Time Test:
52. Simulate Heavy Load Condition (HLC).
53. Heavy load shall be an occurrence of 50 percent of total connected binary COV, one-half of which represent an "alarm" condition, and 50 percent of total connected analog COV, one-half of which represent an "alarm" condition, that are initiated simultaneously on a one-time basis.
54. Initiate 10 successive occurrences of HLC and measure response time to typical alarms and status changes.
55. Measure with a timer having at least 0.1-second resolution and 0.01 percent accuracy.
56. Purpose of test is to demonstrate DDC system, as follows:
57. Reaction to COV and alarm conditions during HLC.
58. Ability to update DDC system database during HLC.
59. Passing test is contingent on the following:
60. Alarm reporting at printer beginning no more than 10 seconds after the initiation (time zero) of HLC.
61. All alarms, both binary and analog, are reported and printed; none are lost.
62. Compliance with response times specified.
63. Prepare and submit a report documenting HLC tested and results of test including time stamp and print out of all alarms.

3.06 DDC SYSTEM NETWORK BANDWIDTH TEST:

- A. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated HLC.
 1. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

3.07 EXTENDED OPERATION TEST

- A. Extended operation test is intended to simulate normal operation of DDC system by Owner.
- B. Operate DDC system for an operating period of 28 consecutive calendar days following Substantial Completion. Coordinate exact start date of testing with Owner.
- C. Provide an operator familiar with DDC system installed to man an operator workstation during eight hours of each normal business day occurring during operating period.
- D. During operating period, DDC system shall demonstrate correct operation and accuracy of monitored and controlled points as well as operation capabilities of sequences, logs, trends, reports, specialized control algorithms, diagnostics, and other software indicated.

1. Correct defects of hardware and software when it occurs.
- E. Definition of Failures and Downtime during Operating Period:
 1. Failed I/O point constituting downtime is an I/O point failing to perform its intended function consistently and a point physically failed due to hardware and software.
 2. Downtime is when any I/O point in DDC system is unable to fulfill its' required function.
 3. Downtime shall be calculated as elapsed time between a detected point failure as confirmed by an operator and time point is restored to service.
 4. Maximum time interval allowed between DDC system detection of failure occurrence and operator confirmation shall be 0.5 hours.
 5. Downtime shall be logged in hours to nearest 0.1 hour.
 6. Power outages shall not count as downtime, but shall suspend test hours unless systems are provided with UPS and served through a backup power source.
 7. Hardware or software failures caused by power outages shall count as downtime.
- F. During operating period, log downtime and operational problems are encountered.
 1. Identify source of problem.
 2. Provide written description of corrective action taken.
 3. Record duration of downtime.
 4. Maintain log showing the following:
 5. Time of occurrence.
 6. Description of each occurrence and pertinent written comments for reviewer to understand scope and extent of occurrence.
 7. Downtime for each failed I/O point.
 8. Running total of downtime and total time of I/O point after each problem has been restored.
 9. Log shall be available to Owner for review at any time.
- G. For DDC system to pass extended operation test, total downtime shall not exceed 1 percent of total point-hours during operating period.
 1. Failure to comply with minimum requirements of passing at end of operating period indicated shall require that operating period be extended one consecutive day at a time until DDC system passes requirement.
- H. Evaluation of DDC system passing test shall be based on the following calculation:
 1. Downtime shall be counted on a point-hour basis where total number of DDC system point-hours is equal to total number of I/O points in DDC system multiplied by total number of hours during operating period.
 2. One point-hour of downtime is one I/O point down for one hour. Three points down for five hours is a total of 15 point-hours of downtime. Four points down for one-half hour is 2 point-hours of downtime.
 3. Example Calculation: Maximum allowable downtime for 30-day test when DDC system has 1000 total I/O points (combined analog and binary) and has passing score of 1 percent downtime is computed by $30 \text{ days} \times 24 \text{ h/day} \times 1000 \text{ points} \times 1 \text{ percent}$ equals 7200 point-hours of maximum allowable downtime.
- I. Prepare test and inspection reports.

3.08 FUNCTIONAL TESTS

- A. Functional Test schedule shall be coordinated with the Commissioning Authority.
- B. Submit forms for approval. Test schedule shall be coordinated with the Commissioning Authority.

- C. Tests may be witnessed by an Owner's Representative at the Owner's option.
- D. All approved Functional Tests shall be conducted by the DDCS Contractor with results confirmed and signed by the Contractor's start-up technician.
 - 1. Seasonal Impacts: It shall be assumed that not all tests will be possible due to weather conditions. Those that are not possible shall be deferred until the next season, performed during the warranty period.
- E. Test documentation shall be submitted to the Owner for review and approval.

3.09 DEMONSTRATION TEST

- A. Demonstration tests consist of a representative sample of functional tests and systems randomly selected by the Commissioning Authority. Tests will be designed to occur over no longer than 2 working days.
- B. Schedule the demonstration with the Commissioning Authority at least 1 week in advance.
- C. Demonstration shall not be scheduled until the Functional Test Report has been approved.
- D. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor-supplied personnel shall be those who conducted the Functional tests or who are otherwise competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems.
- E. The system will be demonstrated following procedures that are the same or similar to those used in the Pre-Functional and Functional Tests. The Commissioning Authority will supply the test forms at the site at the start of the tests.
- F. Contractor shall conduct tests as directed by and in the presence of the Commissioning Authority and complete test forms. Completed forms shall be submitted as the Demonstration Test Report to the Commissioning Authority after tests are complete.
- G. Demonstration Tests shall be successfully completed and approved prior to Substantial Completion.

3.10 COMMISSIONING TREND TEST

- A. Trend logging shall not commence until Demonstration Tests are successfully completed.
- B. Hardware Points: Contractor shall configure all hardware points to trend with the following qualifications.
 - 1. Unless approved otherwise by the Commissioning Authority, all points shall be trended on a 5 minute interval during the Commissioning tests and system evaluation.
 - 2. Commissioning Authority may request certain Trends based on a Change of Value, with COV sensitivity at +/- 1% of the Maximum expected value of the analog point.
- C. Software Points: Include the following in trends of systems and zones whose hardware points are being trended as called for above. Time interval shall be the same as associated hardware point.
 - 1. All setpoints and limits that are automatically reset, plus the points that are driving the reset (For example, % Chilled water Valve Open driving the chilled water distribution system Differential pressure setpoint)
 - 2. All setpoints that are adjustable by Operator

3. Outputs of all control loops, other than those driving a single AO point that is already being trended
 4. System mode points (e.g. Charge Mode of TES, Discharge Mode, etc..)
 5. Global overrides such as demand shed signals
- D. Submit for review and approval by the by Commissioning Authority a table of points to be trended along with trend intervals or change-of-value a minimum of 14 days prior to trend collection period.
- E. Upload trend data from control panels to the control system server on a user-defined interval, manual command, or automatically when the trend buffer becomes full.
- F. Trend logs of all points indicated above shall be collected for a 3 week Trend Period.
- G. At the completion of the Trend Period, data shall be reviewed by the Contractor to ensure that the system is operating properly. If so, data shall be submitted to the Commissioning Authority in an electronic format agreed to by the Commissioning Authority and Contractor and as summarized below (e.g. CD-ROM or via direct access to the control system server via the internet).
- H. Data shall be exported to one of the following formats for analysis by external software.
1. Text (Comma or tab delimited with "" text delimiters)
 2. MS Excel Worksheet
 3. MS Access Database Tables
 4. SQL Database Tables
 5. Exported data shall have the following characteristics:
 - a. There shall be no duplicate records. Each time/date stamp for a specific point shall be unique.
 - b. The data shall be fully contained in a single file or table for each point. Data shall not span multiple files or database tables.
 - c. Each field of data shall have one and only one unique identifier. The label shall be in the first row of the file. Labels shall not be repeated in the stream of data.
 - d. Each table or file shall have a single date/time stamp. Multiple fields that are
 - e. sampled on the same time stamp can be combined in a single file or table provided that they have the same number of records and are stored in the following format:

| | | | |
|----------------|----------|------------|----------|
| Date/Time | Field 1 | Field2 ... | Field n |
| DateTimeValue1 | Value 11 | Value 21 | Value n1 |
| DateTimeValuej | Value 1j | Value 2j | Value nj |

- f. Date/Time fields shall be in a single column in a format automatically recognized by MS Access or MS Excel.
- g. Data will be analyzed over approximately a two- to three-week period by the Commissioning Authority.
- h. The system shall be accepted only if the trend review indicates proper system operation without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. If any glitches are indicated in the trends, including minor glitches, steps F to G above shall be repeated for the same Trend Period until there is a complete Trend Period of error free operation.
- i. At the end of the successful Commissioning Trend Tests all points shall be reconfigured to trend on either a 15 minute interval or a COV of +/- 5% of scale for analog values and COV for digital values.

3.11 REMEDIAL WORK

- A. Remedial work identified by site reviews, review of submittals, demonstration test, trend reviews, etc. shall be performed to the satisfaction of the Commissioning Authority, at no additional cost to the Owner.
- B. Contractor shall compensate Engineer and Commissioning Authority on a time and material basis at standard billing rates for any additional time required to witness additional demonstration tests or to review additional DDCS trends beyond the initial tests, at no additional cost to the Owner. Refer to owners commissioning requirements for additional requirements.

3.12 TRAINING

- A. Coordinate schedule and materials with Commissioning Authority.
- B. Interim Training
 - 1. Provide minimal training so the operating staff can respond to occupant needs and other operating requirements during start-up and commissioning phase.
- C. Formal Training
 - 1. Provide training sessions for personnel indicated in § 3.12G.
 - 2. Training shall be conducted after all commissioning is complete and systems are fully operational.
 - 3. The length of each training period will depend on the complexity of the system and the audience, described below. Minimum training shall be 40 hours, but period shall be longer if required to complete the training tasks described below.
 - 4. Training may be in non-contiguous days at the request of the Owner.
 - 5. Owner shall be permitted to videotape training sessions.
 - 6. During the warranty period, provide unlimited telephone support for all trained operators.
- D. Operators are divided into three categories and shall receive training including but not limited to the tasks listed.
 - 1. Day-to-day Operators shall be trained to:
 - a. Proficiently operate the system
 - b. Understand control system architecture and configuration
 - c. Understand DDC system components
 - d. Understand system operation and control sequences
 - e. Operate the workstation and peripherals
 - f. Log on and off the system
 - g. Access graphics, point reports, and logs
 - h. Adjust and change system set points, time schedules, and holiday schedules
 - i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
 - j. Understand and acknowledge alarms
 - k. Understand system drawings, and Operation and Maintenance manual
 - l. Understand the job layout and location of control components
 - m. Create, delete, and modify point trend logs, and graph or print these both on an ad-hoc basis and at user-definable time intervals
 - n. Print point and predefined reports
 - 2. Advanced Operators shall be trained to do all items for Day-to-day operators plus:
 - a. Make and change graphics on the workstation
 - b. Create, delete, and modify alarms, including annunciation and routing

- c. Create, delete, and modify reports
 - d. Add, remove, and modify system's physical points
 - e. Create, modify, and delete programming
 - f. Add control panels
 - g. Add Operator Workstations
 - h. Create, delete, and modify system displays — both graphical and otherwise
 - i. Perform DDC system field checkout procedures
 - j. Perform DDC controller unit operation and maintenance procedures
 - k. Perform workstation and peripheral operation and maintenance procedures
 - l. Perform DDC system diagnostic procedures
 - m. Configure hardware including PC boards, switches, communication, and I/O points
 - n. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
 - o. Adjust, calibrate, and replace system components
 - p. Maintain software and prepare backups
3. System Managers/Administrators shall be trained to do all items for Day-to-day operators plus:
- a. Maintain software and prepare backups
 - b. Create and print custom reports, including tenant billing summaries
 - c. Interface with job-specific, third-party operator software
 - d. Add new users and understand password security procedures
- E. Provide an outline and any and all course materials required for training. As a minimum, training materials shall include step-by-step instructions (including illustrations, screen captures, etc.) for performing all tasks identified in Paragraph 3.6D such that a new trainee, one who has not previously attended a training session and who has minimal familiarity with this DDCS system, can easily follow the instructions and successfully perform the tasks. One copy of training material shall be provided per student in the format specified this Section.
- F. The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- G. The type and number of personnel and location for training shall include.
- 1. Day-to-day Operator: 1
 - 2. Advanced Operator: 1
 - 3. System Managers/Administrators: 1

END OF SECTION

SECTION 23 09 95

MECHANICAL SYSTEMS COMMISSIONING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. System specific commissioning
 - 2. Mechanical systems to be commissioned are as follows:
 - a. All Direct Digital Controls and control sequences related to HVAC systems incorporated into the contract documents.
 - b. Process measurement instruments and gauges
 - c. Alarms and notification
 - d. Trending and data export
 - e. Graphical user interface
 - f. Control system and sequences
- B. Related Sections:
 - 1. Division 1 Submittals Procedures
 - 2. Division 1 Contract Closeout Procedures
 - 3. Division 1 Operation and Maintenance Data
 - 4. 23 09 70 Division 23 DDC System Commissioning

1.02 DESCRIPTION OF WORK – Refer to owners commissioning requirements

1.03 SUBMITTALS – Refer to owners commissioning requirements

PART 2 PRODUCTS – Refer to owners commissioning requirements

PART 3 EXECUTION

3.01 COMMISSIONING PROCESS AND PROCEDURES – Refer to owners commissioning requirements

3.02 PRE-FUNCTIONAL CHECKLIST

- A. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report.
- B. Regardless of whether the CA includes them or not, checks, inspections, safety measures, quality control measures and start-up procedures recommended by the manufacturer shall be implemented by the Contractor prior to initiation of the commissioning activity.
- C. The Commissioning Coordinator (CC) employed by the Contractor shall be responsible for directing all Pre-Functional Check lists provided by the CA. The CC shall engage subcontractors and vendors service representatives with expertise in the specific equipment or system to determine whether the equipment or system passes the checks detailed in the Pre-Functional Checklist.

- D. CC shall communicate the actual schedule for the execution of the Pre-Functional Checks to the CA as provided by the owner.
- E. The Commissioning Authority (CA) may choose to participate in the inspection of items along with the Contractor and his specialty subcontractors and vendors. In addition, CA reserves the right to inspect any or all of the items on his own in order to satisfy that the installation conforms to the design objectives and the system is ready for Functional Testing.
- F. For additional information on how the Pre-Functional Checklists fits within the overall framework of Commissioning as well as the Contractor's obligations under the same, please Refer to owners commissioning requirements.

3.03 FUNCTIONAL PERFORMANCE TESTING

- A. Contractor shall assist the Commissioning Authority (CA) in developing the Working Functional Performance Test (FPT) Procedures (also named Functional Test Plans - FTPs) as specified in owners commissioning requirements. For any given equipment or system subcontractors and equipment suppliers associated with and specializing in the specific equipment are required to participate in developing the working procedures for the indicated FPTs. It is conceivable that for certain equipment and systems, multiple subcontractors and specialties may be required to participate to contribute to the development of the Functional Test. Contractor shall extend his full cooperation to the CA in securing the subcontractor or supplier resources necessary to develop and implement the Functional Tests.
- B. The Contractor's Commissioning Coordinator is required to manage the subcontractors in developing the Working FPT Procedures and Data Forms, and in performing all FPT's.
- C. Though not developed specifically for this project, the sample Functional Test procedures shown in Section 23 09 95 - Exhibit B are provided as an indication of the format and rigor of the required functional testing procedures and documentation.
- D. CA may approve certain equipment performance tests to be conducted at the factory. If so, Contractor shall make arrangements and pay for travel costs for Owner and the CA to visit the factory and witness such tests at the factory.
- E. Contractor shall be responsible for demonstrating the successful testing of 100% of the systems to be commissioned per the Functional Test plans and procedures provided by the CA.
- F. CA shall develop the Functional Test following review of all contractor submittals. The Functional Test documents shall be made available immediately upon the successful completion of the Pre-Functional Check Lists and correction of all issues identified in the Pre-Functional Checklist.
- G. Contractor shall allow a reasonable time frame after the completion of TAB activities to schedule and conduct the Functional Tests. Functional tests shall commence only upon completion of the TAB activities and all flows and measurement data established through the TAB process are available for the Commissioning Agent's review. In no event shall the commissioning Functional Test duration be less than four weeks, plus what is reasonably required to correct issues identified and time required for retest and back-check. Contractor shall coordinate the work of other disciplines so that commissioning test procedures are not interrupted as a result of work that needs to be performed inside or outside the building.
- H. Refer to owners commissioning requirements for additional requirements regarding Functional Tests.

END OF SECTION

SECTION 23 09 95

EXHIBIT A - SAMPLE PRE-FUNCTIONAL CHECKLIST (PFC) FOR HEATING BOILER

A. Submittal/Approvals

| | | | |
|------------------------------|-------|----------------------|-------|
| Project Name: | _____ | | |
| Equipment Tag (ID) | _____ | Installed On: | _____ |
| Location: | _____ | PFC Completion Date: | _____ |
| Sub-Contractor(s) Signature: | _____ | Date: | _____ |
| Contractor(s) Signature: | _____ | Date: | _____ |

By signing this check list, the sub-contractor performing work and contractor confirm that they have diligently examined the installation with respect to the items shown herein and the installation details match what is specified in the plans and specifications and conform to manufacturer's written instructions. Exceptions are noted under the comment column as noted below.

B. Model Verification

| | |
|----------------------------|--|
| Manufacturer | |
| Model | |
| Serial Number | |
| Capacity BTUH | |
| Peak Design Flowrate (GPM) | |
| | |

C. Pre-Functional Checks

| Tag | | YES | NO | Comments |
|------|---|-----|----|----------|
| 1 | DOCUMENTATION | | | |
| | <i>Verify if the following items have been submitted:</i> | | | |
| 1.01 | Manufacturer's cut sheets including performance data (if available) | | | |
| 1.02 | Installation and startup manual / plan | | | |
| 1.03 | O&M manuals | | | |
| 1.04 | Control sequences | | | |

| Tag | | YES | NO | Comments |
|------|--|-----|----|----------|
| 2 | GENERAL INSTALLATION | | | |
| 2.01 | General appearance good, no apparent damage | | | |
| 2.02 | Proper vibration isolators installed and adjusted | | | |
| 2.03 | Seismic restraints in place | | | |
| 2.04 | Boiler system checked out | | | |
| 2.05 | Combustion air provided | | | |
| 2.06 | Drains provided | | | |
| 2.07 | Gas piping connected | | | |
| 2.09 | No gas leakage | | | |
| 2.17 | Adequate Boiler & accessory access for maintenance | | | |
| 3 | PIPING | | | |
| 3.01 | Hydronic piping complete | | | |
| 3.02 | Hydronic system flushing complete and strainers cleaned | | | |
| 3.03 | Piping insulation in good condition where visible | | | |
| 3.04 | Piping not supported on chiller or valves | | | |
| 3.05 | Pipe fittings and accessories complete | | | |
| 3.06 | Piping type and flow direction labeled on piping | | | |
| 3.07 | Isolation valves and balancing valves installed | | | |
| 3.08 | Pressure gauges & thermometers installed where specified | | | |
| 3.09 | Test ports/plugs installed near all control sensors and per spec | | | |
| 3.10 | Flow switch installed as required | | | |
| 3.11 | Flow meters installed as required | | | |
| 4 | ELECTRICAL & CONTROLS | | | |
| 4.01 | Power wiring installed properly | | | |
| 4.02 | All electrical components grounded properly | | | |
| 4.03 | Control wiring and control system hooked up | | | |

| Tag | | YES | NO | Comments |
|------|--|-----|----|----------|
| 4.04 | Sensors calibrated (see calibration section below) | | | |
| 4.05 | Control system interlocks hooked up and functional | | | |
| 4.07 | All control devices and wiring complete | | | |
| 4.08 | Safeties installed and safe operating ranges for this equipment provided to the commissioning agent | | | |
| 4.09 | Heating, Hot- water pumps pre-functional checklists completed | | | |
| 5 | OPERATIONAL | | | |
| 5.01 | No unusual noise and vibration when running | | | |
| 5.07 | Specified sequences of operation and operating schedules have been implemented with all variations documented | | | |
| 5.08 | Specified point-to-point checks have been completed and documentation record submitted for this system | | | |
| 5.09 | Startup report completed with this checklist attached. (Includes full listing of all internal settings with notes as to which settings are BAS controlled or monitored and which are integral. | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

END OF EXHIBIT

SECTION 23 09 95

EXHIBIT B - SAMPLE FUNCTIONAL TEST PROCEDURE (FTP) FOR HEATING COILS

Functional Test Plan

Heating, Hot-Water System

Project: Scripps Anderson Outpatient Clinic Boiler Replacement

1. Objective:

Confirm satisfactory operation of heating, hot-water system.

2. Equipment:

| | EQUIPMENT | MARK | MODEL |
|----|-----------|------|-------|
| 1. | | | |

3. Participants

| | NAME | COMPANY | FUNCTION | ROLE |
|----|------|---------|----------|--|
| 1. | | | | Party filling out this form |
| 2. | | | | Party operating equipment and executing the test |
| 3. | | | | Party witnessing / observing the test |

4. Prerequisite Checklist:

| | ITEM | √ |
|----|--|---|
| 1. | The following have been started up and startup reports and prefunctional checklists submitted and approved ready for functional testing: _____ Heating, Hot-water coils | |
| 2. | All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules and with debugging, loop tuning and sensor and device calibrations completed. | |
| 4. | Piping system flushing complete and required report approved. | |
| 5. | Occupants (if any) notified that testing in progress and zone temperatures will be significantly out of normal range | |
| 6. | Water treatment system complete and operational. | |
| 7. | Vibration control report approved (if required). | |

| | ITEM | √ |
|-----|---|---|
| 8. | Test and balance (TAB) complete and approved for the hydronic system | |
| 9. | All A/E punchlist items for this equipment corrected. | |
| 10. | These functional test procedures reviewed and approved by installing contractor. | |
| 11. | Safeties and operating ranges reviewed. | |
| 12. | Sufficient clearance around equipment for servicing. | |
| 14. | Parameters, setpoints and logic sequences appear to follow the specified written sequences. Attach sequence of operation to this test. | |
| 15. | Record made of all values (i.e., Setpoints, Control Parameters, Limits, Delays, Lockouts, Schedules, etc.) changed to accommodate testing. Attach as necessary. | |
| | | |

5. Seasonal Testing Note:

Due to the building completion being during winter, this test will be completed in two stages. The first testing will occur during cold weather. The objective of this first stage test is to provide reasonable assurance that the boiler will function properly during higher load conditions. This will prepare the boiler for operation during the beginning of the cooling season (lower load). As many of the test procedures as possible will be executed during this first stage of testing, through the use of the methods of artificial loading or partial loading. Stage 2 tests for low load condition tests will not be executed until summer.

END OF EXHIBIT

SECTION 23 21 13

HYDRONIC PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Hot-water heating piping.
 - 2. Air-vent piping.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Plastic pipe and fittings with solvent cement.
 - 2. RTRP and RTRF with adhesive.
 - 3. Pressure-seal fittings.
 - 4. Chemical treatment.
- B. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
 - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
 - 4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Other building services.
 - 3. Structural members.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. 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

2.01 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the working pressure and temperature as required by project design requirements.

2.02 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Star Pipe Products.
 - c. Victaulic Company.

2.03 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, 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 A 234/A 234M, 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. Grooved Mechanical-Joint Fittings and Couplings (at equipment connections only):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Grinnell Mechanical Products.
 - c. Victaulic Company.
 - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.04 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 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 B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- 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.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.05 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Charlotte Pipe and Foundry Company.
 - b. IPEX USA LLC.
 - c. KBI (King Bros. Industries).
 - 2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
- B. Plastic-to-Metal Transition Unions:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX USA LLC.
 - c. KBI (King Bros. Industries).
 - d. NIBCO INC.
 - 2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.06 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts; a Watts Water Technologies company.
 - d. Wilkins.
 - e. Zurn Industries, LLC.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts; a Watts Water Technologies company.
 - d. Wilkins.
 - e. Zurn Industries, LLC.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 psig minimum at 180 deg F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.

- b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products.
 - e. Victaulic Company.
 - 2. Description:
 - a. Standard: IAPMO PS 66.
 - b. Electroplated steel nipple, complying with ASTM F 1545.
 - c. Pressure Rating: 300 psig at 225 deg F.
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered brazed joints.
 - 2. Schedule 40, Grade B, Type 96 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.02 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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 Section 23 05 23 "General duty Valves for HVAC," Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- Q. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- R. Install shutoff valve immediately upstream of each dielectric fitting.
- S. Comply with requirements in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- T. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

3.03 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.04 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 23 05 48 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet.
 - 2. NPS 1: Maximum span, 7 feet.
 - 3. NPS 1-1/2: Maximum span, 9 feet.
 - 4. NPS 2: Maximum span, 10 feet.
 - 5. NPS 2-1/2: Maximum span, 11 feet.
 - 6. NPS 3 and Larger: Maximum span, 12 feet.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.05 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. 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.
- H. Grooved Joints: (Only to be used at equipment connections) Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.06 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 bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 05 19 "Meters and Gages for HVAC Piping."

3.07 CHEMICAL TREATMENT

- A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:
 - 1. pH: 9.0 to 10.5.
 - 2. "P" Alkalinity: 100 to 500 ppm.
 - 3. Boron: 100 to 200 ppm.

4. Chemical Oxygen Demand: Maximum of 100 ppm. Revise this value if closed system contains glycol.
 5. Corrosion Inhibitor:
 - a. Sodium Nitrate: 1000 to 1500 ppm.
 - b. Molybdate: 200 to 300 ppm.
 - c. Chromate: 200 to 300 ppm.
 - d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
 - e. Chromate Plus Molybdate: 50 to 100 ppm each.
 6. Soluble Copper: Maximum of 0.20 ppm.
 7. Tolyriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum of 10 ppm.
 8. Total Suspended Solids: Maximum of 10 ppm.
 9. Ammonia: Maximum of 20 ppm.
 10. Free Caustic Alkalinity: Maximum of 20 ppm.
 11. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maximum of 1000 organisms/mL.
 - b. Total Anaerobic Plate Count: Maximum of 100 organisms/mL.
 - c. Nitrate Reducers: 100 organisms/mL.
 - d. Sulfate Reducers: Maximum of zero organisms/mL.
 - e. Iron Bacteria: Maximum of zero organisms/mL.
- B. Install bypass chemical feeders in each hydronic system where indicated.
1. Install in upright position with top of funnel not more than 48 inches above the floor.
 2. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
 3. Install NPS 3/4 pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.
- C. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- D. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.08 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

SECTION 23 21 16

HYDRONIC PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes special-duty valves and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Air-vent piping.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Hydronic specialties.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.05 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.

1.06 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. 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

2.01 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the working pressure and temperature as required by the project design.

2.02 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 23 05 23 "Valves for HVAC Piping.
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 23 09 23 "direct digital control (DDC) system for HVAC."
- C. Plastic Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Asahi/America.
 - b. Charlotte Pipe and Foundry Company.
 - c. NIBCO INC.
 - d. Thermoplastic Valves, Inc.
 - 2. Body: One-, two-, or three-piece CPVC or PVC to match piping.
 - 3. Ball: Full-port CPVC or PVC to match piping.
 - 4. Seats: PTFE.
 - 5. Seals: EPDM.
 - 6. End Connections: Socket, union, or flanged.
 - 7. Handle Style: Tee shape.
 - 8. CWP Rating: Equal to piping service.
 - 9. Maximum Operating Temperature: Equal to piping service.
 - 10. Comply with MSS SP-122.
- D. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett; a Xylem brand.
 - c. Flow Design, Inc.
 - d. TACO Comfort Solutions, Inc.
 - e. Tour & Andersson.
 - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Plug: Resin.
 - 5. Seat: PTFE.
 - 6. End Connections: Threaded or socket.
 - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 8. Handle Style: Lever, with memory stop to retain set position.
 - 9. CWP Rating: Minimum 125 psig (860 kPa).
 - 10. Maximum Operating Temperature: 250 deg F (121 deg C).

2.03 AIR-CONTROL DEVICES

- A. Manual Air Vents:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; a Xylem brand.
 - d. TACO Comfort Solutions, Inc.
 - 2. Body: Bronze.
 - 3. Internal Parts: Nonferrous.

4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/8.
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; a Xylem brand.
 - d. Spirotherm, Inc.
 - e. TACO Comfort Solutions, Inc.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/4 (DN 8).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 240 deg F (116 deg C).

2.04 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, 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, 40-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

B. Expansion Fittings: Comply with requirements in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping." Section 15124 "Expansion Fittings and Loops for HVAC Piping."

PART 3 EXECUTION

3.01 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install throttling-duty valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with

ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.02 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.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
- G. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 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. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports 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 SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.04 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Sealants and gaskets.
 - 2. Seismic-restraint devices.
- B. 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, and static-pressure classes.
 - 4. Elevation of top of ducts.

5. Dimensions of main 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.
- C. 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.
- D. Coordination Drawings: 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Sprinklers.
 - d. Access panels.
- E. Welding certificates.
- F. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 PRODUCTS

2.01 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.
- B. Transverse Joints: Select joint types and fabricate according to 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."
- C. Longitudinal Seams: Select seam types and fabricate according to 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."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 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."

2.02 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGill AirFlow LLC.
 - b. SEMCO Incorporated.
 - c. Sheet Metal Connectors, Inc.
- 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 according to 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 according to 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 according to 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."

2.03 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 A 653/A 653M.
1. Galvanized Coating Designation: G90.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. 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.

2.04 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 according to 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. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. 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. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Base: Synthetic rubber resin.
 3. Solvent: Toluene and heptane.
 4. Solids Content: Minimum 60 percent.
 5. Shore A Hardness: Minimum 60.
 6. Water resistant.
 7. Mold and mildew resistant.
 8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 9. VOC: Maximum 395 g/L.
 10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 12. Service: Indoor or outdoor.
 13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.05 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. 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."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. 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.

2.06 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. B-Line, an Eaton Business
 2. Kinetics Noise Control.
 3. Mason Industries.
 4. Unistrut; part of Atkore International.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. 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.
- D. Restraint Cables: ASTM A 603, galvanized -steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 EXECUTION

3.01 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.

- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. 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.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.02 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Return-Air Ducts: Seal Class C.

4. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
6. Unconditioned Space, Exhaust Ducts: Seal Class C.
7. Unconditioned Space, Return-Air Ducts: Seal Class B.
8. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
10. Conditioned Space, Exhaust Ducts: Seal Class B.
11. Conditioned Space, Return-Air Ducts: Seal Class C.

3.04 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, 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.

3.05 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 SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 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 an agency acceptable to authorities having jurisdiction.
- 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 the 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.

3.06 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 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 Division 09 painting Sections.

3.08 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, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.

- c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - d. Exhaust Ducts with a Pressure Class of 2-Inch wg 3-Inch wg 4-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, 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 3-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 100 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. Test for leaks before applying external insulation.
 - 5. 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.
 - 6. 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 according to "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.

3.09 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation as recommended by manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 6. Supply-air ducts, dampers, actuators, and turning vanes.
 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, or duct accessories.
 4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 5. Provide drainage and cleanup for wash-down procedures.
 6. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Supply Ducts:
1. Ducts Connected to Air Handling Units and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
 2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 3.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 3.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- B. Return Ducts:
1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.

- b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- C. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- D. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- E. 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.
 - b. Velocity 1000 fpm or Higher:
 - 1) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 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 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 2) 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: Welded.
- F. 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: 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

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Combination fire and smoke dampers.
 - 3. Flange connectors.
 - 4. Turning vanes.
 - 5. Duct-mounted access doors.
 - 6. Flexible connectors.
 - 7. Flexible ducts.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- 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. Duct security bars.
 - f. Wiring Diagrams: For power, signal, and control wiring.

1.04 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.
- B. Source quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 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

2.01 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.

2.02 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 2 finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. 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.

2.03 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. Flexmaster U.S.A., Inc.
 - c. Nailor Industries Inc.
 - d. Pottorff.
 - e. Ruskin Company.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Frame: Hat-shaped, 0.094-inch-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, 0.064 inch thick.
- 6. Blade Axles: Galvanized steel.
- 7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 8. Tie Bars and Brackets: Galvanized steel.

2.04 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Greenheck Fan Corporation.
 - 2. Pottorff.
 - 3. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S 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: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded corners.
- F. Heat-Responsive Device: Resettable, 165 deg F rated, fusible links.
- G. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- H. Smoke Detector: Integral, factory wired for single-point connection.
- I. Blades: Roll-formed, horizontal, interlocking, 0.063-inch-0.034-inch-thick, galvanized sheet steel.
- J. Leakage: Class I.
- K. Rated pressure and velocity to exceed design airflow conditions.
- L. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application.
- M. Master control panel for use in dynamic smoke-management systems.
- N. Damper Motors: Modulating action.
- O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "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. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 23 09 00 "Instrumentation and Control for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

P. Accessories:

1. Auxiliary switches for signaling or position indication.

2.05 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. METALAIRE, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Double wall.

2.06 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Cesco Products; a division of Mestek, Inc.
 2. Ductmate Industries, Inc.
 3. Greenheck Fan Corporation.
 4. Nailor Industries Inc.
 5. Pottorff.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 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. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
- 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
- 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: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
 - 1. Door and Frame Material: Galvanized sheet steel.
 - 2. Door: Single wall with metal thickness applicable for duct pressure class.
 - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
 - 4. Factory set at 3.0- to 8.0-inch wg.
 - 5. Doors close when pressures are within set-point range.
 - 6. Hinge: Continuous piano.
 - 7. Latches: Cam.
 - 8. Seal: Neoprene or foam rubber.
 - 9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.07 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches 5-3/4 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.
- E. 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.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd..

2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd..
 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.
- I. 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. Outdoor 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.

2.08 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. CASCO
 2. Flexmaster U.S.A., Inc.
 3. McGill AirFlow LLC.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-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/IESNA 90.1.
- C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
 2. Non-Clamp Connectors: Adhesive.

2.09 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. All manual volume dampers shall be installed in accessible locations. If manual volume dampers are installed above hard lid ceilings, where access is not attainable, flush mounted, keyed, cable type remote damper controllers shall be provided. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in all branch ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. 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. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. 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.
 - 7. At each change in direction and at maximum 50-foot spacing.
 - 8. Upstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. 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.
- K. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- P. Connect flexible ducts to metal ducts with adhesive.
- Q. Install duct test holes where required for testing and balancing purposes.
- R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.02 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 purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 36 00

HYDRONIC HEATING COILS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Duct Mounted Hydronic Heating Coils

1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance: 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" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems".
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.

1.04 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Hydronic Heating Coils.
- B. Shop Drawings: For heating coils. 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.
 - 3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 2. 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.
- D. 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. Size and location of initial access modules for acoustic tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- E. Field quality-control reports.

- F. Operation and Maintenance Data: For heating coils to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.05 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: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 PRODUCTS

2.01 HYDRONIC HEATING COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Trane.
 - 2. Titus.
 - 3. Price.
- C. Configuration: Duct mounted, 2-row hydronic heating coils.
- D. Construction: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

2.02 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated 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. Steel Cables: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Heating coil Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.03 SEISMIC-RESTRAINT DEVICES

- A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- 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 A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; with an automatic-locking and clamping device or double-cable clips.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or 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 according to ASTM E 488.

2.04 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled heating coil units according to ARI 880.
 - 1. Label each heating coil with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install air heating coils units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air heating coils level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.02 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, 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 and for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.

3.03 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install hangers and braces designed to support the air heating coils and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- 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 seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- E. 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.
- F. Drilling for and Setting Anchors:
1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the 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. Install heavy-duty sleeve anchors 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.

3.04 CONNECTIONS

- A. Install piping adjacent to air heating coils to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to heating coils according to Division 23 Section "Metal Ducts."
- D. Make connections to air heating coils with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.05 IDENTIFICATION

- A. Label each heating coil with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.06 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 inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.
- D. Tests and Inspections:
 - 1. After installing air heating coil and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils 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 proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Heating coil will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.07 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air heating coil unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.08 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain heating coils.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Modular core supply grilles.
 - 2. Fixed face registers and grilles.
- B. Related Sections:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 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, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. 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.
- C. Source quality-control reports.

PART 2 PRODUCTS

2.01 CEILING DIFFUSERS

- A. Modular Core Supply Grilles:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on drawings or a comparable product by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Nailor Industries.

- c. Krueger.
- d. Price Industries.
- e. Titus.
- 3. Throw: Extended distance for airflow rates.
- 4. Material: Steel.
- 5. Grilles per Unit: Four.
- 6. Finish: White baked acrylic.
- 7. Border: 1-1/2-inch width with countersunk screw holes. And 24x24 filler panel.
- 8. Blades:
 - a. Set in modules.
- 9. Modules: Removable; rotatable.
- 10. Mounting: Surface and lay-in tee bar with filler panel.
- 11. Accessory: Opposed-blade steel damper.

2.02 REGISTERS AND GRILLES

- A. Fixed Face Register:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on drawings or a comparable product by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Nailor Industries
 - c. Krueger.
 - d. Price Industries.
 - e. Titus.
 - 3. Material: Steel or Aluminum.
 - 4. Finish: Baked enamel, white.
 - 5. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
 - 6. Core Construction: Integral.
 - 7. Frame: 1 inch wide.
 - 8. Mounting: Countersunk screw.
 - 9. Damper Type: Adjustable opposed blade.

2.03 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be 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.

3.02 INSTALLATION

- A. Install diffusers, registers, and grilles 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, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 26 00 10

ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE

- A. Work Included: 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 Section, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to, the following:
 - 1. Examine all other sections for work related to those other sections and required to be included as work under this section.
 - 2. General provisions and requirements for electrical work.
- B. Organization of the specifications into divisions, sections and articles, and arrangement of drawings shall not control the CONTRACTOR in dividing the contract work among subcontractors or in establishing the extent of work to be performed by any trade.

1.02 GENERAL SUMMARY OF ELECTRICAL WORK

- A. The specifications and drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the CONTRACTOR from providing such additional labor and materials.
- B. Refer to the drawings and shop drawings of other trades for additional details, which affect the proper installation of this work. Diagrams and symbols showing electrical connections are diagrammatic only. Wiring diagrams do not necessarily show the exact physical arrangement of the equipment.
- C. Before submitting a bid, the CONTRACTOR shall become familiar with all features of the building drawings and site drawings, which may affect the execution of the work. No extra payment will be allowed for failure to obtain this information.
- D. If there are omissions or conflicts between the drawings and specifications, clarify these points with the OWNER'S REPRESENTATIVE before submitting bid.
- E. Provide work and material in conformance with the manufacturer's published recommendations for respective equipment and systems.

1.03 LOCATIONS OF EQUIPMENT

- A. The drawings indicate diagrammatically the desired locations or arrangements of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structure conditions encountered.
- B. Where outlets are placed on a wall, locate symmetrically with respect to each other and other features or finishes on the wall.

- C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes made without cost, providing the change is ordered before the conduit runs, etc., and work directly connected to same is installed and no extra materials are required.
- D. Lighting fixtures in mechanical spaces are shown in their approximate location only. Do not install light outlets or fixtures until mechanical piping and ductwork is installed; then install lights in a location to provide best lighting.
- E. Coordinate and cooperate in every way with other trades in order to avoid interference and assure a satisfactory job.
- F. The location of the existing utilities, building, equipment and conduit shown on the drawings is approximate. Verify exact locations and routing of existing systems by potholing all trench routes prior to digging the trench. Pothole at least 100 feet ahead of the actual trenching to allow space to alter the new conduit routing to accommodate existing conditions.
- G. Underground detection services existing utility structures
 1. Services shall be provided utilizing the latest detection equipment available. Services shall be performed by a company regularly engaged in the business of existing Underground Utility Structure Detection for the past five years.
 2. Prior to excavation the following work shall be performed:
 - a. Contractor to mark trenching locations and indicate width and depth.
 - b. Locate, by way of vertical and horizontal control dimensions, existing subgrade petroleum product pipes, process piping, conduits, sewer, water, gas, storm drain, electrical, telephone and irrigation lines in the affected areas of contract construction work.
 - c. Arrange and meet with the OWNER'S Representative to review existing underground conditions.
 - d. The proposed route of each excavation shall be continuously surveyed along the entire excavation path using ground-penetrating radar (GPR) operating from the surface grade. The GPR shall detect and map existing underground metal and non-metal private and public utility lines, pipes, conduits, conductors, etc. The GPR shall identify the horizontal and vertical location of existing underground conditions located at a depth of up to 3 meters below finish grade and located with a vertical and horizontal accuracy within $\pm 12"$ of actual condition.
 3. Exercise extreme caution in excavating and trenching on this site to avoid existing underground utilities, and to prevent hazard to personnel and/or damage to existing underground utilities or structures. These drawings and specifications do not include necessary components for construction safety, which is the responsibility of the CONTRACTOR.
 4. Repair/replace, without additional cost to the contract, and to the satisfaction of the OWNER any existing work damaged that was identified in the record drawings provided; Identified by the Owner's Representative; Identified by the Underground Detection Services performed; or any existing work damaged as a result of failure to comply with all the referenced requirements.
 5. The CONTRACTOR shall contact Underground Service Alert (USA) of Southern California, at least 48 hours prior to excavation, and shall not excavate until verification has been received from the USA and that public utilities serving the site have been located and marked.
- H. The locations of existing underground utilities, where shown on drawings, are shown diagrammatically and have not been independently verified by the OWNER, the OWNER'S

REPRESENTATIVE. The OWNER, the OWNER'S REPRESENTATIVE, and the OWNER's Consulting ENGINEER'S are not responsible for the location of underground utilities or structures, whether or not shown or detailed and installed under this or any other contracts. The CONTRACTOR shall identify each existing utility line prior to excavation and mark the locations on the ground of each existing utility line.

1.04 AIR CONDITIONING, HEATING, PLUMBING EQUIPMENT WIRING

- A. Provide electrical work, materials, and control components required for proper operation of the air conditioning, heating and plumbing systems as indicated on the electrical, mechanical, and plumbing Contract Documents and specified herein.

1.05 POWER SERVICES

- A. Within 30 calendar days of receipt of notice that the contract award has been made, the CONTRACTOR shall notify the New Business Departments of the District Office of the serving utility companies concerning the project contract and shall provide information as to the total lighting and power requirements of the contract. The CONTRACTOR shall furnish at the same time information as to the estimated completion date of job or the date when the respective utility company circuits, will be ready for installation, energizing and activation of the respective services.

1.06 PERMITS

- A. Take out and pay for all required permits, inspections and examinations without additional cost to the OWNER.

1.07 QUALITY ASSURANCE

- A. Work and materials shall be in full accordance with the latest rules and regulations as follows. The following publications shall be included in the contract documents requirements. If a conflict occurs between the following publications and any other part of the contract documents, the requirements describing the more restrictive provisions shall become the applicable contract definition:
 - 1. California Code of Regulations Title 24.
 - 2. California Part 3 "California Electrical Code" CEC, Title 24 and Title 8 "Division of Industrial Safety".
 - 3. California Electrical Code-CEC.
 - 4. The National Life Safety Code.
 - 5. The Uniform Building Code-UBC.
 - 6. National Fire Protection Agency-NFPA.
 - 7. Underwriter's Laboratory-U.L.
 - 8. Other applicable State and Local Government Agencies laws and regulations.
 - 9. National Electrical Installation Standards
 - 10. National Electrical Contractors Association (NECA) and National Electrical Installation Standards (NEIS):
 - a. NECA/NEIS-1: Standard of Practices for Good Workmanship in Electrical Contracting
 - b. NECA/NEIS-101: Standard for Installing Steel Conduit (Rigid, IMC, etc.)
 - c. NECA/NEIS-400: Recommended Practice for Installing and Maintaining Switchboards
 - d. NECA/NEIS-402: Recommended Practice for Installing and Maintaining Motor Control Centers
 - e. NEIS/NECA Recommended Practice for

- & EGSA-404: Installing Generator Sets
 - f. NEIS/NECA Recommended Practice for
& IESNA-500: Installing Indoor Commercial Lighting Systems
 - g. NEIS/NECA Recommended Practice for
& IESNA-501: Installing Exterior Lighting Systems
 - h. NEIS & IESNA-502 Recommended Practice for Installing Industrial Lighting Systems
- B. All material and equipment shall be new and shall be delivered to the site in unbroken packages. All material and equipment shall be listed and labeled by Underwriters Laboratories or other recognized testing laboratories, where such listings are available. Comply with all installation requirements and restrictions pertaining to such listings.
- C. Work and material shown on the drawings and in the specifications is new and included in the contract unless specifically indicated as existing or N.I.C. (not in contract).
- D. Keep a copy of all applicable codes available at the job site at all times while performing work under this section. Nothing in plans or specifications shall be construed to permit work not conforming to the most stringent of codes.
- E. Where a conflict or variation occurs between applicable Codes, the provisions of the most restrictive code shall be the requirement of the Contract Documents. Where a conflict or variation occurs between applicable Codes and the Contract Documents, the requirements of the most restrictive provision(s) shall be the requirement of the Contract Document.

1.08 SUBMITTALS

- A. General
 - 1. Review of CONTRACTOR'S submittals is for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. CONTRACTOR is responsible for quantities; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of work with that of all other trades and satisfactory performance of their work.
 - 2. The CONTRACTOR shall review each submittal in detail for compliance with the requirements of the contract documents prior to submittal. The CONTRACTOR shall "Ink Stamp" and sign each item of the submittal with a statement "CERTIFYING THE SUBMITTAL HAS BEEN REVIEWED BY THE CONTRACTOR AND COMPLIES WITH ALL THE REQUIREMENTS OF THE CONTRACT DOCUMENTS". The CONTRACTOR shall clearly and specifically identify each individual proposed substitution or proposed deviation from the requirements of the contract documents with a statement "THIS ITEM IS A SUBSTITUTION".
 - 3. Departure from the submittal procedure will result in resubmittals and delays. Failure of the CONTRACTOR to comply with the submittal requirements shall render void any acceptance or any approval of the proposed variation. The CONTRACTOR shall then be required to provide the equipment or method without variation from the contract documents and without additional cost to the contract.
 - 4. The CONTRACTOR at no additional cost or delays to the contract shall remove any work, material and correct any deficiencies resulting from deviations from the requirements of the contract documents not approved in advance by the OWNER prior to commencement of work.
 - 5. Shop drawings submitted by the CONTRACTOR, which are not specifically required for submittal by the Contract Documents, or CONTRACTOR shop drawings previously

reviewed and resubmitted without a written resubmittal request to the CONTRACTOR, will not be reviewed, considered, or commented on. The respective shop drawing submittal/resubmittal will not be returned to the CONTRACTOR and will be destroyed without comment or response to the CONTRACTOR. The respective submittal shall be considered null and void as being not in compliance with the requirements of the Contract Documents.

B. Material Lists and Shop Drawings:

1. Submit material list and equipment manufacturers for review within 35 days of award of contract. Give name of manufacturer and where applicable, brand name, type and/or catalog number of each item. Listing of more than one manufacturer for any one item of equipment, or listing items "as specified", without both make and model or type designation, is not acceptable. Shop drawings shall not be submitted before review completion of manufacturers list. The right is reserved to require submission of samples of any material whether or not particularly mentioned herein.
2. After completion of review of the material and equipment manufacturers list, submit shop drawings for review. Shop drawings shall be submitted in completed bound groups of materials (i.e., all lighting fixtures or all switchgear, etc.). The CONTRACTOR shall verify dimensions of equipment and be satisfied as to fit and that they comply with all code requirements relating to clear working space about electrical equipment prior to submitting shop drawings for review. Submittals, which are intended to be reviewed as substitution or departure from the contract documents, must be specifically noted as such or the requirements of the contract documents will prevail regardless of the acceptance of the submittal.
3. Shop drawings shall include catalog data sheets, instruction manuals, dimensioned plans, elevations, details, wiring diagrams and descriptive literature of component parts where applicable. Structural calculations and mounting details, signed by a Structural ENGINEER registered by the State of California, shall be submitted for all equipment weighing over four hundred pounds, and shall be in compliance with Title 21 of the California Code of Regulations.
4. Each shop drawing item shall be identified with the specification section and paragraph numbers, lighting fixture types and drawing sheet numbers; the specific shop drawing is intended to represent. Shop drawings 11" x 17" or smaller in size shall be bound in 3-ring binders. Divider tabs shall be provided in the 3-ring binders identifying and separating each separate shop drawing submittal item. Shop drawings larger than 11" x 17", shop drawing pages/sheets submittals shall be sequentially numbered with unique alphanumeric numbering system to facilitate correspondence referencing identification of individual sheets.
5. The time required to review and comment on the CONTRACTOR'S submittals will not be less than 14 calendar days, [or more than 21 calendar days] after receipt of the submittals at the office of Donn C. Gilmore & Associates. The review of CONTRACTOR submittals and return to CONTRACTOR of submittals with review comments will occur in a timely manner conditioned upon the CONTRACTOR complying with all of the following:
 - a. The submittals contain complete and accurate information, complying with the requirements of the Contract Documents.
 - b. CONTRACTOR'S submittals are each marked with CONTRACTOR'S approval "stamp", and with CONTRACTOR signatures.
 - c. The submittals are received in accordance with a written, shop drawing submittal schedule for each submittal. The CONTRACTOR distributes the schedule not less than 35-day calendar days in advance of the Shop Drawing Submittals, and the schedule identifies the calendar dates, the CONTRACTOR will deliver the various submittals for review.
6. Shop drawings shall include the manufacturers projected days for shipment from the factory of completed equipment, after the CONTRACTOR releases the equipment for

production. It shall be the responsibility of the CONTRACTOR to insure that all material and equipment is ordered in time to provide an orderly progression of the work. The CONTRACTOR shall notify the OWNER'S Representative of any changes in delivery, which would affect the project completion date.

7. Submittal Identification

- a. Each submittal shall be dated: with submittal transmission date; sequentially numbered and titled with submittal contents identification and applicable specification/drawing references (*i.e. Submittal dated: 5/12/98 Submittal #4 Contents: Branch circuit panelboards Sheet #E5.1 and transformers Specification Section 16050 Paragraph 2.11, etc.*).
- b. Each resubmittal shall be dated: with original submittal date and resubmittal transmission dates; sequentially numbered with original submittal number and sequential resubmittal revision number and titled with submittal contents identification and applicable specifications/drawing references (*i.e. Original Submittal Date: 5/12/98 Resubmittal Date: 10/9/98 Original Submittal #4 resubmittal Revision R2 Contents: Transformer resubmittal Specification Section - 16050 Paragraph 2.11, etc.*)

C. The CONTRACTOR shall be responsible for incidental, direct and indirect costs resulting from the CONTRACTOR'S substitution of; or changes to; the specified contract materials and work.

D. The CONTRACTOR shall pay, upon request by the OWNER'S Representative, \$125.00 per hour for the OWNER'S Representative time involved in the review of substitution submittals and design changes resulting from the CONTRACTOR'S requested substitutions.

E. Maintenance and Operating Manuals

1. The CONTRACTOR shall furnish three copies of typewritten maintenance and operating manuals for all electrical equipment, fire alarm equipment, nurse call system equipment, etc., to the OWNER.
2. Instruct OWNER'S personnel in correct operation of all equipment at completion of project. Provide the quantity and duration of instruction class as specified; but in no case less than two (2) four (4) hour duration separate instruction classes for each individual equipment group furnished as part of the contract. Instruction classes shall be presented by Manufacturer's authorized field service ENGINEER at the project site. Instruction class size shall be at the OWNER'S discretion, not less than one (1) or more than fifteen (15) students shall attend each instruction session. Submit 15-written outline copies of the proposed instruction class curriculum, 14 days prior to the class scheduled dates.
3. Maintenance and operating manuals shall be bound in three-ring, hard-cover, plastic binders with table of contents. Manuals shall be delivered to the OWNER'S Representative, with an itemized receipt.

F. Portable or Detachable Parts: The CONTRACTOR shall retain in his possession, and shall be responsible for all portable and detachable parts or portions of the installation such as fuses, keys, locks, adapters, locking clips, and inserts until final completion of contract work. These parts shall then be delivered to the OWNER's Representative with an itemized receipt.

G. Record Drawings

1. Provide and maintain in good order a complete set of electrical contract "record" prints. Changes to the contract to be clearly recorded on this set of prints. At the end of the project, transfer all changes to one set of transparencies to be delivered unfolded to the OWNER'S Representative.

2. The actual location and elevation of all buried lines, boxes, monuments, vaults, stub-outs and other provisions for future connections shall be referenced to the building lines or other clearly established base lines and to approved bench marks. If any necessary dimensions are omitted from the record drawings, the CONTRACTOR shall, at his own expense, do all excavation required to expose the buried work and to establish the correct locations.
3. The CONTRACTOR shall keep the "record" prints up to date and current with all work performed.

1.09 CLEANING EQUIPMENT, MATERIALS, PREMISES

- A. All parts of the equipment shall be thoroughly cleaned of dirt, rust, cement, plaster, etc., and all cracks and corners scraped out clean. Surfaces to be painted shall be carefully cleaned of grease and oil spots and left smooth, clean and in proper condition to receive paint finish.

1.10 JOB CONDITIONS - PROTECTION

- A. Protect all work, materials and equipment from damage from any cause whatever and provide adequate and proper storage facilities during the progress of the work. Provide for the safety and good condition of all the work until final acceptance of the work by the OWNER and replace all damaged or defective work, materials and equipment before requesting final acceptance.

1.11 EXCAVATION, CUTTING, BACKFILL AND PATCHING ADDITIONAL REQUIREMENTS.

- A. General
 1. Perform excavation, cutting, backfill, core drilling, directional boring, and patching of the construction work required for the proper installation of the electrical work.
 2. Patching shall be of the same material, thickness, workmanship and finish as existing and accurately match surrounding work to the satisfaction of the OWNER'S Representative.
- B. Excavation Temporary cover
 1. Excavations for contract work occurring in streets, vehicular drive areas, parking lots, sidewalks or any paved surface; provide temporary steel plating and shoring support for the plates, to completely cover the excavations under one or more of the following conditions:
 - a. Excavation shall not remain "open" for more than four (4) calendar days; provide temporary plating.
 - b. Excavation shall not be "open" over weekends (Saturday, Sunday) or Holidays, provide temporary plating.
 2. The temporary plating shall be a minimum of 0.75-inch thickness steel, but in no case shall the thickness be less than required to support AASHO-H20 traffic loading.
 3. Provide a minimum of two (2) [one (1)] 100% open lane(s) (10 ft. width) for vehicular traffic at all times during construction, for vehicle access to all areas.

1.12 IDENTIFICATION

- A. Equipment Nameplates
 1. Panelboards, terminal cabinets, circuit breakers, disconnect switches, starters, relays, time switches, contactors, push-button control stations, and other apparatus used for the operation or control of feeders, circuits, appliances, or equipment shall be properly identified by means of descriptive nameplates or tags permanently attached to the apparatus and wiring.

2. Nameplates shall be engraved laminated phenolic. Shop drawings with dimensions and format shall be submitted before installation. Attachment to equipment shall be with escutcheon pins, rivets, self-tapping screws or machine screws. Self-adhering or adhesive backed nameplates shall not be used.
 3. Provide black-on-white laminated plastic nameplates engraved in minimum 1/4" high letters to correspond with the designations on the drawings. Provide other or additional information on nameplates where indicated.
- B. Plates: All cover and device plates shall be furnished with engraved or etched designations under any one of the following conditions (minimum character size not less than 0.188 inch. Engraving shall indicate circuits and equipment controlled or connected):
1. More than two devices under a common coverplate.
 2. Lock switches.
 3. Pilot switches.
 4. Switches in locations from which the equipment or circuits controlled cannot be readily seen.
 5. Manual motor starting switches.
 6. Where so indicated on the drawings.
 7. As required on all control circuit switches, such as heater controls, motor controls, etc.
 8. Receptacles other than standard 15 ampere 120 volt duplex receptacles; shall indicate circuit voltage, ampere, phase and source circuit number.
 9. Where outlets or switches are connected to emergency power circuit; provide panelboard and circuit number engraved on plate.
- C. For equipment and access doors or gates to equipment containing or operating on circuits of more than 240 volts nominal, provide red-on-white laminated warning signs engraved in 1/2" high letters to read: "DANGER - 480 (or applicable voltage) VOLTS KEEP OUT AUTHORIZED PERSONNEL ONLY".
- D. Wire and Cable Identification
1. Provide identification on individual wire and cable including signal systems, fire alarm, electrical power systems (each individual phase, neutral and ground), empty conduit pull ropes, and controls circuit.
 2. Permanent identification shall be provided at each termination location, splice location, pullbox, junction box and equipment enclosure.
 - a. Individual wire and cable larger than #6 AWG or 0.25 inch diameter, shall be provided with polypropylene identification tag holders, with yellow polypropylene tags interchangeable black alpha/numeric characters, character height 0.25 inch. Attach identification tags with plastic "tie" wraps, minimum of two for each tag. As manufactured by Almetek Industries-"EZTAG" series; or TECH Products - "EVERLAST" series.
 - b. Individual wire and cable #6 AWG and smaller or smaller than 0.25 inch diameter, shall be provided with water and oil resistant, flexible, pressure sensitive machine embossed plastic tags that wrap a minimum of 360 degrees around the wire/cable diameter. The entire tag shall then be covered with a clear flexible waterproof plastic cover wrapped a minimum of 540 degrees around the wire/cable diameter and completely covering the identification.
 - c. Each identification tag location shall indicate the following information: circuit number, circuit phase, source termination and destination termination equipment name (or outlet number as applicable).
 3. Install permanent identification after installation/pulling of wire/cable is complete, to prevent loss or damage to the identification.
- E. Cardholders and cards shall be provided for circuit identification in panelboards. Cardholders shall consist of a metal frame retaining a clear plastic cover permanently

attached to the inside of panel door. List of circuits shall be typewritten on card. Circuit description shall include name or number of circuit, area, and connected load.

- F. Junction and pull boxes shall have covers stenciled with box number when shown on the drawings, or circuit numbers according to panel schedule. Data shall be lettered in a conspicuous manner with a color contrasting to finish.

1.13 TESTING

- A. The CONTRACTOR shall obtain an independent testing laboratory that will provide all instrumentation and tests on the electrical system and equipment as hereinafter described and further directed by the OWNER's Representative. The test shall be performed after the completion of all electrical systems included in the Contract Scope of Work. All tests shall be recorded and documented and submitted to the OWNER'S Representative for review.
 - 1. Test for Phase to Ground and Neutral Condition:
 - a. Open main service disconnects.
 - b. Isolate the system neutral from ground by removing the neutral disconnects link located in the service switchboard.
 - c. Close all submain disconnects.
 - d. Close all branch feeder circuit breakers.
 - e. Turn all switches to "on" position, unplug all portable equipment from outlet receptacles.
 - f. Measure the resistance of each phase to ground and phase to neutral. A properly calibrated "megger" type test instrument shall be used. The test voltage shall be a nominal 500 volts.
 - g. Record all readings after one minute duration and document into a complete report.
 - 2. Isolating Grounds: In the event that low resistance ground neutral connections are found in the system, they shall be isolated and located by testing each circuit individually as outlined above. Make proper corrections to restore the resistance values to an acceptable value.
- B. Method of obtaining ground resistance shall be in accordance with the latest edition of the James G. Biddle (Plymouth Meeting, Pennsylvania) manual published on this subject.
 - 1. Perform "fall-of-potential" 3-point tests on the main grounding electrode of system per IEEE Standard No. 81, Section 8.2.1.5. when suitable locations for test rods are not available, a low resistance dead earth or reference ground shall be utilized.
 - 2. Perform the two-point method test per IEEE Standard No. 81, Section 8.2.1.1, to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
 - 3. Where the existing surface or subsurface conditions prevent the installation of auxiliary test "driven" ground rods (electric potential test probes), the ground test "driven" ground rods may substitute a "lazy-spike" test alternative. The test instrumentation shall be designed and approved by the test instrument manufacturer to use portable test electrodes instead of temporary "driven" test electrodes (ground rods). The portable test electrodes shall be "coiled" metal chains of flexible metalized grounding mat (lazy-spike) which may lay on the surface on existing undisturbed grade.
- C. All equipment and personnel required for testing shall be furnished by the CONTRACTOR.
- D. The testing, calibrating and setting of all ground and ground fault equipment circuit breakers, device protection relays, and meters adjustable settings shall be by an

independent testing laboratory. Set as recommended by the respective manufacturer and coordination study so as to be coordinated with other protection devices within the electrical design. Bound and tabulated copies of the test and settings shall be sent to the OWNER'S Representative.

- E. Ampere and voltage measurements:
 - 1. Take and record ampere and line voltage measurements under full load on all panel feeders, switchboard and switchgear feeders, motor control centers and motor circuits provided in the contract. Record measurements at the equipment tested and submit to the OWNER'S Representative for review.
 - 2. Ampere voltage readings shall be:
 - a. Phase A-B, A-C and B-C.
 - b. Phase A-Neutral, B-Neutral and C-Neutral.
 - 3. The ampere and voltage readings shall be not less than 20 minutes duration for each test. Record and submit the measured minimum, maximum and 20 minute average for each ampere and voltage value and test location. Voltage and ampere measurements shall occur at the connected load end of each respective feeder, not at the source of supply end of each feeder.
 - 4. Test equipment shall be accurate within plus or minus 1-percent.
 - 5. Branch circuit devices 40 ampere or less and motor loads 10 horsepower or smaller are excluded from ampere and voltage testing requirement.
 - 6. If, in the opinion of the OWNER'S Representative, the voltages and regulations are not met within acceptable limits, make arrangements with the serving utility for proper electrical service. Retest feeder line voltages, and submit to OWNER'S Representative for review, after the utility company has completed corrective actions. Reset "voltage taps" on transformers provided or modified as part of the contract work, to adjust line voltages to within acceptable values, as directed by the OWNER'S Representative.
- F. The Contractor shall complete the following work before any electrical equipment is energized:
 - 1. All equipment shall be permanently anchored.
 - 2. All bus connections shall be tightened per manufacturer's instructions and witnessed by the OWNER'S Representative.
 - 3. All ground connections shall be completed and identified. Perform and successfully complete all required megger and ground resistance tests.
 - 4. All feeders shall be connected and identified.
 - 5. The interiors of all electrical enclosures including busbars and wiring terminals shall be cleaned of all loose material and debris, paint, plaster, cleaners or other abrasive's overspray removed and equipment vacuumed clean. The OWNER'S Representative shall observe all interiors before covers are installed.
 - 6. All dry wall work and painting shall be completed within areas containing electrical equipment prior to installation of equipment.
 - 7. All doors to electrical equipment rooms shall be provided with locks in order to restrict access to energized equipment.
 - 8. Electrical rooms shall not be used as a storage rooms after power is energized.
 - 9. The electrical system coordination study shall be complete for circuit breakers, ground relays sets, and circuit relay sets, fuses; tested and calibrated accordingly.

1.14 POWER OUTAGES

- A. All electrical services in all occupied facilities of the contract work are to remain operational during the entire contract period. Any interruption of the electrical services for the performance of this work shall be at the convenience of the OWNER and performed only

after consultation with the OWNER'S Representative. Work involving circuit outages shall be only at such a time and of such a duration as approved in writing. Work involving circuit outages for the work required to connect new equipment and disconnect existing equipment shall be performed at the convenience of the OWNER.

- B. Contract work involving outages or disruption of normal function in electrical power systems, telephone/communication systems, fire alarms, shall be performed during the following time periods. The contract work shall be phased to limit outages in the respective systems to the stated periods:
 - 1. 11:30 p.m. Friday to 11:30 p.m. Sunday of the same weekend. Work shall occur on multiple weekend periods if a single weekend is not sufficient time to complete the work.
 - 2. The contract work involving outages shall be phased in multiple work time units, to comply with the permitted outage limitations.
- C. Work involving system outages to the building fire alarm system shall be performed only after consultation with the OWNER and shall be only at such a time and of such duration as approved in writing.
- D. Provide overtime work; double shift work; night time work; Saturday, Sunday, and holiday work to meet outages schedule.
- E. Provide temporary electrical power to meet the requirements of this Article.
- F. Any added costs to CONTRACTOR due to necessity of complying with this Article shall be included in the Contract Scope of Work.
- G. When electrical work involving power disruptions to existing areas is initiated, the work shall proceed on a continuous basis without stopping until electric power is restored to the affected areas.
- H. The CONTRACTOR shall request in writing to the OWNER'S Representative a minimum of three weeks in advance, for any proposed electrical outage.

1.15 ASBESTOS, POLYCHLORINATED BIPHENYL (PCB) OR HAZARDOUS WASTE

- A. It is understood and agreed that this contract does not contemplate the handling of asbestos, PCB or any hazardous waste material. If asbestos, PCB or any hazardous waste material is encountered, notify the OWNER'S Representative immediately. Do not disturb, handle or attempt to remove.

1.16 SERIES RATED EQUIPMENT

- A. Circuit protective Devices identified as "Series Rated" or "Current Limiting" (i.e. CLCB - current limiting circuit breaker; CLF - current limiting fuse, etc.) shall be series rated and tested (UL 489 & CSA5) by the manufacturer with all equipment and circuit protective devices installed down stream of the identified series rated or current limiting device. Provide nameplates on all equipment located down stream, including the CLCB and CLF devices, to comply with N.E.C. paragraphs 110-22 and 240-83 "CAUTION SERIES RATED SYSTEM - NEW DEVICE INSTALLATIONS AND REPLACEMENTS SHALL BE THE SAME MANUFACTURER AND MODELS".

1.17 INDEPENDENT TESTING LABORATORY

- A. The Testing Laboratory shall meet Federal OSHA criteria for accreditation of Testing Laboratories Title 29 Part 1907.
- B. Membership in the National Electrical Testing Association shall constitute proof of meeting said criteria, for testing of electrical systems.

1.18 SPARE FUSES

- A. Provide three (3) spare fuses [for each size and type] [at each location] to match the installed fuses where the fuses are provided as part of the Contract. Provide spare fuse holders on inside door of each respective fuse compartment. Provide engraved nameplate on front of fuse access door indicating fuse type/catalog number ampere rating and manufacturer of fuse.

1.19 EQUIPMENT SEISMIC REQUIREMENTS

- A. Equipment supports and anchorage's provided as part of the contract shall be designed, constructed and installed in accordance with the earthquake regulations of the California Code, Title 24, Section 2312, and the Uniform Building Code (UBC).
- B. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of that type of equipment.
- C. The equipment manufacturer shall certify that the equipment can withstand, and function following the seismic event, including both vertical and lateral required response spectra as specified in California Title 24 and the UBC. Alternatively, the manufacturer's certification may be based on an approved detailed structural analysis of the assembly, as specified in California Title 24 and the UBC.
- D. The equipment manufacturer shall document the details necessary for proper seismic mounting, anchorage, and bracing of the equipment for back installation location.
- E. Seismic qualification shall be considered achieved when the capability of the provided equipment, as described by the test response spectra, meets or exceeds the required response spectra as specified in California Title 24 and the UBC, for all equipment natural frequencies up to 35 HZ.
- F. The seismic requirements are typical for each equipment item exceeding 100 pounds, including but not limited to the following:
 - 1. Switchgear, switchboards, and motor control centers
 - 2. Transformers
 - 3. Equipment racks
 - 4. Panels
 - 5. Conduits with ceiling or wall support suspension attachments.
 - 6. Busway and cable tray
 - 7. Uninterruptable power supplies (UPS)
 - 8. Generators and related equipment
 - 9. Lighting equipment

1.20 ELECTRICAL WORK CLOSEOUT

- A. Prepare the following items and submit to the OWNER'S REPRESENTATIVE before final acceptance.
 - 1. Two copies of all test results as required under this section.

2. Two copies of local and/or state code enforcing authorities final inspection certificates.
3. Copies of record drawings as required under the General Conditions, pertinent Division One Sections and Electrical General Provisions.
4. Two copies of all receipts transferring portable or detachable parts to the OWNER'S Representative when requested.
5. Notify the OWNER's Representative in writing when installation is complete and that a final inspection of this work can be performed. In the event any defect or deficiencies are found during this final inspection they shall be corrected to the satisfaction of the OWNER's Representative before final acceptance can be issued.
6. List of spare fuses and locations identified by equipment name and building designation.
7. Prior to energizing, retighten to the proper torque, each circuit conductor lug landing, each bus bar (phases, neutral and ground) and circuit protection device threaded connections in all switchboards, switchgear, motor control centers, transformers, busways, disconnect switches, motor starters, motor terminals and panelboards, after the equipment is installed/connected and prior to energizing the equipment. The torque values shall comply with manufacturer's recommendations.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For sleeve seals.

1.05 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 PRODUCTS

2.01 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.02 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.03 GROUT

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

PART 3 EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.03 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.04 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
 - 1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association 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.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.06 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- C. Copper Conductors: Comply with NEMA WC 70.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and SO.
- E. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.02 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.03 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.04 SLEEVE SEALS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- C. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Feeders in Cable Tray: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

- H. Branch Circuits in Cable Tray: Type THHN-THWN, single conductors in raceway.
- I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- J. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- K. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.

2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- D. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association 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.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 PRODUCTS

2.01 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
 - 1. No. 4 AWG minimum, soft-drawn copper.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.
- D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

2.02 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.03 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet in diameter.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.

2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum.
 1. Bury at least 24 inches below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.03 CONDUIT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Where nonmetallic conduit is used in the distribution system, the CONTRACTOR shall install the proper sized copper ground wire in the conduit with the feeder for use as an equipment ground. The electrical metallic raceway system shall be grounded to this ground wire.
- C. The maximum ground/bond resistance to the grounding electrode shall not exceed 1 ohms from any location in the electrical system. The maximum ground resistance of the grounding electrode to earth shall not exceed 5 ohms.
- D. Ground/Bond Conductors
 - 1. Provide an additional, dedicated, green insulation equipment ground/bond wire inside each conduit type as follows. The metal conduit shall not be permitted to serve (function) as the only (exclusive) electrical ground return path:
 - a. All types of nonmetallic conduit raceways including but not limited to: RNMC - Rigid Nonmetallic Conduit.
 - b. FMC - Flexible Metal Conduit.
 - c. LTFMC - Liquid Tight Flexible Metal Conduit.
 - d. RMC - Rigid Metal Conduit.
 - e. EMT - Electrical Metal Tubing.
 - 2. The equipment ground/bond wire shall be continuous from the electrical circuit source point of origin to the electrical circuit end termination utilization point as follows:
 - a. Every conduit path containing any length of the above identified conduits.
 - b. Every conduit path connected to any length of the above-identified conduits.
 - 3. The equipment ground/bond wire shall be sized as follows, but in no case smaller than indicated on the drawings. Install equipment ground/bond wire in each conduit/raceway, with the respective phase conductors:
 - a.

| Feeder, Subfeeders & Branch Circuit Protection | Minimum Equipment Ground Wire Size |
|---|---------------------------------------|
| 15 Amp | #12 |
| 20 Amp | #12 |
| 30 to 60 Amp | #10 |
| 70 to 100 Amp | #8 |
| 101 to 200 Amp | #6 |
| 201 to 400 Amp | #2 |
| 401 to 600 Amp | #1 |
| 801 to 1000 Amp | 2/0 |
| 1001 to 1200 Amp | 3/0 |
| 1201 to 1600 Amp | 4/0 |
| 1601 to 2000 Amp | 250 MCM |
| 2001 to 2500 Amp | 350 MCM |
| 2501 to 4000 Amp | 500 MCM |
 - 4. Isolated grounds - Raceways containing branch circuit or feeder phase conductors connected to panelboards equipment, or receptacles with isolated grounds or isolated ground bus shall contain a dedicated insulated ground conductor connected to the isolated ground system only. The isolated ground conductor shall be continuous the length of the raceways and connected only to the isolated ground terminals in addition to and independent of the equipment bonding/ ground conductor. The isolated ground conductor shall be sized as indicated above, for equipment ground/bond wire.
 - 5. Splices in ground/bond wires shall be permitted only at the following locations:

- a. Ground buses with listed and approved ground lugs.
 - b. Where exothermic welded ground/bond wire splices are provided.
- 6. Provide ground/bond wire jumpers for conduit fittings with ground lugs, expansion and deflection conduit fittings at conduit fittings connecting between metallic and non-metallic raceways and to bond metal enclosures to conduit fittings with ground lugs.
- E. Where conductors are run in parallel in multiple raceways, the grounding conductor shall be run in parallel. Each parallel equipment-grounding conductor shall be sized on the basis of the ampere rating of the overcurrent device protecting the circuit conductors in the raceway. When conductors are adjusted in size to compensate for voltage drop, grounding conductors, where required, shall be adjusted proportionately in size.
- F. Ground conductors for branch circuit wiring shall be attached at each outlet to the back of the box using drilled and tapped holes and washer head screws, 6-32 or larger.
- G. Each panelboard, switchboard, pull box or any other enclosure in which several ground wires are terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.
- H. Provide a separate ground/bond insulated grounding electrode conductor, copper wire from the main electrical service ground bus to each of the following locations. The ground/bond conductor shall be sized to comply with applicable codes and as indicated on the drawings, but in no case smaller than the following:
 - 1. Each transformer (size as indicated and to comply with applicable codes).
 - 2. Generator 1.5 inch conduit with 1#4/0.

3.04 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 - 10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.05 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches from building foundation.
- J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- C. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- D. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 2. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 3. Substations and Pad-Mounted Equipment: 5 ohms.
 4. Manhole Grounds: 10 ohms.
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.07 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles.
 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction

boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections 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 A 780.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, wireway, wall duct and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.03 DEFINITIONS

- A. RMC: Rigid metal conduit
- B. EMT: Electrical metallic tubing.
- C. FMC: Flexible metal conduit.
- D. LTFMC: Liquid Tight Flexible metal conduit.
- E. RNMC: Rigid nonmetallic conduit.

1.04 SCOPE

- A. Work Included: 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 Section, complete as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other sections for work related to those other sections and required to be included as work under this section.
 - 2. General provisions and requirements for electrical work.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
 - 2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.

- c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
 - 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.
- E. Qualification Data: For professional engineer and testing agency.
- F. Source quality-control test reports.
- G. Submit material list for outlet boxes, conduit and conduit fittings.
- H. Submit details and structural engineering calculations for conduit support systems.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 METAL CONDUIT AND TUBING

- A. General
 - 1. The interior surfaces of conduits and fittings shall be continuous and smooth, with a constant interior diameter. Conduits and conduit fittings shall provide conductor raceways of fully enclosed circular cross section. The interior surfaces of conduits and fittings shall be without ridges, burrs irregularities or obstructions. Conduits and fittings of the same type shall be of the same uniform weight and thickness.

2. Type of conduit, type of conduit fittings and conduit supports shall be suitable for the conditions of use and the conditions of location of installation, based on the manufacturer's recommendations and based on applicable codes.
 3. All fittings for metal conduit shall be suitable for use as a grounding means, pursuant to the applicable code requirements. All metal conduit and metal conduit fittings shall provide 3 second duration ground fault current carrying ratings, when installed and connected to the respective conduit, as follows:
 - a. RMC and EMT conduit fittings.
 - 1) 0.5 inch through 1.5 inch conduit/fitting size - 10,000 ampere RMS.
 - 2) 2.0 inch and larger conduit/fitting size - 20,000 ampere RMS.
 - b. RMC and EMT conduit fittings.
 - 1) 0.5 inch through 1.25 inch conduit/fitting size-1,000 ampere RMS (without external bonding jumper).
 - 2) 1.5 inch through 4.0 inch fitting size-10,000 ampere RMS with bonding jumper.
 4. Protective corrosion resistant finish for metal conduit fabricated from steel and metal conduit fittings fabricated from steel, shall be as follows:
 - a. Clean all metal surfaces (including metal threads) with acid bath "pickle" prior to coating, to remove dirt, oil and prepare surfaces for galvanizing.
 - b. Hot-dip galvanized zinc coating on all interior and exterior steel surfaces. Minimum finish zinc coating thickness shall not be less than 0.002 inches.
 - c. Threads shall be hot-dip zinc coated after machine fabrication.
 - d. Exterior metal surfaces shall be finished with clear organic polymer topcoat layer, after galvanizing.
 - e. The inner metal surfaces of conduit fittings shall be finished with a lubricating topcoat after galvanizing, to facilitate conductor pulling through the conduit/fitting.
 5. Threads for metal conduit and metal conduit fittings shall be taper-pipe-thread, National Pipe Standards(NPS) and shall comply with ANSI-B1.20.1.
 6. Metal conduit termination connector fittings shall be provided with a manufacturer installed, insulating throat bushing inside the fitting. The bushing shall protect the wire conductor insulation from cutting, nicks and abrasion during conductor installation and electrical load "cycling" after installation is complete. The bushing shall comply with UL 94V-0 flammability.
 7. Provide conduit bonding/grounding jumper from metal enclosures with "concentric ring" knockouts, to positively ground/bond each respective conduit(s) to the metal enclosure.
 8. Metal conduit fittings connecting to PVC coated metal conduit shall be PVC coated to match the conduit.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Appleton
 2. Erickson
 3. O-Z Gedney; a unit of General Signal
 4. Thomas & Betts
- C. RMC: ANSI C80.3.
1. Rigid metal, round tubing, machine threaded at both ends.
 - a. Clean all metal surfaces (including metal threads) with acid bath "pickle" prior to coating, to remove dirt, oil and prepare surfaces for galvanizing.
 - b. The conduit shall be watertight and airtight without cracks and pinholes.

2. RMC raceway types shall be as follows
 - a. Rigid galvanized steel conduit (RGS), minimum yield strength shall be 35,000 PSI. Shall comply with NEMA standard 5-19 (latest revision); ANSI C80.1 and ANSI-C80.4 (latest revision); U.L. 514-B and UL 6 (latest revisions); National Pipe Standard Specification (latest revision).
 - b. Intermediate steel conduit (IMC). Shall comply with NEMA Standard 5-19 (latest revision) ANSI-C80.6 (latest revision); UL 2142 (latest revision).
3. RMC Fittings
 - a. Fittings shall be compatible with RGS and IMC.
 - b. Fittings shall be rated "liquid tight".
 - c. Fittings imbedded in concrete shall be rated "liquid tight" and "concrete tight".
 - d. Connectors and couplings for terminating, connecting and coupling to RMC conduit shall be threaded metal.
 - e. Fittings shall comply with ANSI C80.4 and ANSI C33-84 (latest revision); NEMA FB1 (latest revision); UL 514 (latest revision).
 - f. Conduit Seal Fittings
 - 1) Conduit seals shall prevent the passage of gasses, liquids and vapors past the location of the seal installation in the conduit.
 - 2) Conduit seals shall be suitable for installation in both vertical and horizontal conduit locations.
 - 3) Conduit seals shall be visible and accessible for inspection after installation is complete.
 - 4) Conduit seals shall be rated for the following locations:
 - a) Wet locations
 - b) Classified hazardous location materials NEC Class 1 Division 1.
 - c) Temperature ranges from 0 [minus 20] degrees centigrade through 90 degrees centigrade.
 - 5) Conduit seals, sealing compound and sealing compound dam shall be the products of the same manufacturer.
4. RMC Fittings as manufactured by:
 - a. For threaded enclosure, termination connection.
 - 1) Thomas & Betts - 106 Series bonding locknut, 5302 series sealing ring with stainless steel retainer.
 - b. For non-threaded enclosure, termination connector.
 - 1) Thomas & Betts - 370 Series watertight threaded sealing hub, 106 series threaded bonding lock nut, Sta-Con Series enclosure bonding jumper and 3870 Series threaded ground bushing.
 - 2) OZ/Gedney-CHMT/CHT watertight threaded hub with bonding locknut and GH50G Series enclosure bonding jumper.
 - c. For RMC to RMC conduit-to-conduit coupling
 - 1) Erickson - 674 (threaded) Series
 - 2) OZ/Gedney Type 4 (threaded) Series
 - 3) Threaded RMC conduit couplings, product of the same manufacturer as the RMC conduit.
 - d. For RMC Conduit Seals
 - 1) OZ/Gedney-EYA and EYAM (threaded) Series
 - 2) Appleton-EYF and EYM (threaded) Series

D. EMT: ANSI C80.3.

1. Rigid metal round tubing, "thin wall" steel construction, with non-threaded ends.
 - a. The conduit and conduit fittings shall comply with the requirements for a equipment grounding conductor pursuant to applicable codes.

- b. The conduit shall be watertight and airtight without cracks and pinholes.
 - 2. EMT shall be allowed for conduit size ranges from 0.5 inch through 4.0 inch.
 - 3. Comply with ANSI C80.3, C80.4, and ANSI C33.98 (latest revisions); UL 594 and UL 797 (latest revisions); CEC Section 12500 (latest revision).
 - 4. EMT Fittings
 - a. Connectors and couplings for terminating, connecting and coupling to EMT conduit shall be non-threaded steel fabrication.
 - b. EMT termination connector fittings shall be as follows:
 - 1) Set screw type "concrete tight" when installed in dry interior locations.
 - 2) Compression types "raintight" and "concrete tight" when installed in wet or damp locations, outdoors and in concrete or masonry construction.
 - c. Fittings shall comply with ANSI C33.84 (latest revision); UL 514 (latest revision); NEMA FB-1.
 - 5. EMT Fittings as manufactured by:
 - a. For threaded and non threaded enclosure, termination connector
 - 1) Thomas & Betts-TC5031 (set screw type) Series (with locknuts).
 - 2) OZ/Gedney-4000ST (set screw type) Series.
 - 3) Thomas & Betts-5123 (compression type) Series (with 2 locknuts).
 - 4) OZ/Gedney-7000ST (compression type) Series (with locknut).
 - 5) Thomas & Betts-4240 (compression type) Series (90 degree angle with locknut).
 - 6) OZ/Gedney-8000WT (compression type) Series (90 degree angle with locknut).
 - b. For EMT to EMT conduit-to-conduit coupling:
 - 1) Thomas & Betts-TK121 (set screw type) Series (with locknut).
 - 2) OZ/Gedney-5000 (set screw type) Series (with locknut).
 - 3) Thomas & Betts-5120 (compression type) Series
 - 4) OZ/Gedney-6000S (compression type) Series.
 - c. For EMT to RMC conduit to conduit combination coupling:
 - 1) Thomas & Betts-HT221 (set screw type) Series
 - 2) OZ/Gedney-ESR (set screw type) Series.
 - 3) Thomas & Betts-530 (compression type) Series
 - 4) OZ/Gedney-ETR (compression type) Series.
- E. FMC: Zinc-coated steel.
 - 1. Round flexible conduit, fabricated from a single continuous steel strip. The steel shall be factory formed into continuous interlocking convolutions to form a complete lock between steel strips and provide raceway flexibility.
 - 2. Metal to metal grounding contact shall be maintained throughout the length of the FMC conduit.
 - 3. FMC shall be allowed for conduit size ranges from 0.5 inch through 0.75 inch.
 - 4. FMC shall comply with ANSI-C.33.84 and ANSI C33.92; NEMA FB-1; CEC 12-1100.
 - 5. FMC Fittings
 - a. FMC fittings shall be malleable iron construction or steel construction.
 - b. Fitting shall automatically cause the FMC raceway throat opening to be centered with respect to the fitting throat opening.
 - c. Straight and angled connector termination fittings shall be threaded on one end and shall include a threaded locknut, suitable for connection to threaded and unthreaded enclosures.

- d. The attachment of the fittings to FMC shall be angled saddle type, to engage and interlock with the FMC spiral groove, and shall be unaffected by vibration. Direct bearing screw type fittings shall not be used.
 - e. Direct FMC conduit-to-FMC conduit coupling of FMC shall not be permitted.
 - f. Shall comply with ANSI C33.9, and ANSI C33.92 (latest revision); NEMA FB1 (latest revision); U.L. 514.
 - 6. FMC Fittings as manufactured by:
 - a. Straight Termination 45 & 90 Degree Connectors Angle Connectors
 - 1) Thomas & Betts-Thomas & Betts-3110 Series 3130 Series
 - b. FMC to EMT conduit combination coupling:
 - 1) Thomas & Betts 503TB Series.
- F. LTFMC:
- 1. The metal conduit core of LTFMC shall comply with the same requirements as FMC conduit, with the addition of a thermoplastic exterior flexible jacket over the metal core.
 - 2. The exterior jacket shall be positively locked to the metal core to prevent jacket "sleeving".
 - 3. The LTFMC shall be rated for installation and operating service temperatures of between 0 [minus 20] degrees centigrade through plus 90 degrees centigrade.
 - 4. The LTFMC jacket shall be suitable for continuous exposure to sunlight, rainwater, water vapor, mineral oils and liquid solvents, without penetrating into the conduit and without deteriorating the jacket.
 - 5. LTFMC sizes from 0.5 inch through 1.25 inches shall include an additional internal ground conductor, fabricated by the manufacturer, as a integral part of the conduit core.
 - 6. Direct LTFMC conduit-to-LTFMC conduit coupling of LTFMC shall not be permitted.
 - 7. LTFMC shall be allowed for conduit size ranges from 0.5 inch through 4.0 inches.
 - 8. In addition to the requirements for FMC conduit, LTFMC shall also comply with ANSI C-33.84 (latest revision); NEMA-FB1 (latest revision); CEC 12-1400 (latest revision).
 - 9. LTFMC fittings
 - a. Fittings shall include an external mechanical ground/bond wire connector.
 - b. The attachment of the fitting to LTFMC shall be threaded compression type onto the conduit core with locknut and liquid tight jacket compression seal. The fitting shall automatically prevent "sleeving" of the jacket.
 - c. Straight and angled termination connector fittings shall be threaded on one end and shall include locknut suitable for connection to threaded and unthreaded enclosures.
 - 10. LTFMC Fittings as manufactured by:
 - a. Termination connector fittings Straight 45 and 90 Degree Angle Connectors
 - 1) Thomas & Betts-5331 Thomas & Betts-GR Series. 5341GR and 5351GR Series.
 - 2) Appleton-STB Series; Appleton-STB-L STN-L Series for use Series; STN-L Series with preformed Series for use "knockouts". with preformed "knockouts".
 - 3) OZ/Gedney-4QLT Series. OZ/Gedney-4QLT Series
 - b. For EMT to EMT conduit-to-conduit coupling:
 - 1) Thomas & Betts-5271 GR Series.
 - 2) OZ/Gedney-4QFML Series

- G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 3. Fittings for EMT: Steel type.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.02 NONMETALLIC CONDUIT AND TUBING

- A. General
 - 1. The interior surfaces of conduits and fittings shall be continuous and smooth, with a constant interior diameter. Conduits and conduit fittings shall provide conductor raceways of fully enclosed circular cross section. The interior surfaces of conduits and fittings shall be without ridges, burrs irregularities or obstructions. Conduits and fittings of the same type shall be of the same uniform weight and thickness.
 - 2. Type of conduit, type of conduit fittings and conduit supports shall be suitable for the conditions of use and the conditions of location of installation, based on the manufacturer's recommendations and based on applicable codes.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Appleton
 - 2. Erickson
 - 3. O-Z Gedney; a unit of General Signal
 - 4. Thomas & Betts
- C. RNMC: NEMA TC 2, Type EPC-40-PVC or Type EPC-80-PVC, unless otherwise indicated.
 - 1. General
 - a. Conduit and fittings shall be 90 degree centigrade conductor rated. Fabricated from homogeneous material, free from visible crack holes or foreign inclusions, with integral "end-bell". The conduit and conduit fittings shall be watertight and airtight.
 - b. Conduit, conduit fittings and conduit fitting assembly "solvent cement" shall all be the product of the same manufacturer. Conduit fittings shall be solvent cement welded watertight.
 - c. Conduit and fittings shall be identified with legible markings showing ratings, size and manufacturers name.
 - d. RNMC and fitting shall be corrosion resistant, watertight.
 - e. Conduit shall be suitable for conductor operating temperatures from minus 20 degrees centigrade to 90 degrees centigrade.
 - f. RNMC shall comply with NEMA TC-2 (PVC 40 conduit, latest revision) NEMA TC-6 (EB conduit latest revision) and NEMA TC-3 (fittings, latest revision); UL 514 and UL 651 (latest revision).
 - 2. Polyvinyl Chloride (PVC)-RNMC
 - a. PVC-schedule 40 heavy wall construction.
 - b. PVC-schedule 80 extra heavy wall construction.

- c. PVC-type EB.
- 3. RNMC fittings connecting to metallic raceways shall be provided with a ground/bond jumper connection.

2.03 EXPANSION JOINT, DEFLECTION JOINT AND SEISMIC JOINT CONDUIT FITTINGS

- A. Expansion Conduit Fitting - Fitting shall provide for a minimum of two (2) inches straight line movement between two connecting conduits in each direction (total four (4) inches conduit expansion and contraction) parallel to the respective conduit lengths. Fitting shall be watertight.
- B. Deflection Conduit Fitting - Fitting shall provide for a minimum of 30 degrees angular deflection movement ("Shear" deflection) between two connecting conduits, in any direction perpendicular to the length of the respective conduits. Fitting shall be watertight.
- C. Combination Expansion/Deflection Conduit Fitting - Fitting shall provide the combined "expansion" and "deflection" movement capacity between two connecting conduits as described for separate "expansion" and "deflection" conduit fittings. Fitting shall be approved for installation concealed in both masonry/concrete construction and exposed non-masonry/concrete construction. Fitting shall be watertight.
- D. Fittings shall comply with U.L.
- E. Fittings as manufactured by:
- F. Conduit expansion fittings exposed or concealed locations as manufactured by:
 - 1. OZ/Gedney - AX8 Series for RMC conduit.
 - 2. OZ/Gedney - TX Series for EMT conduit
 - 3. Appleton - XJ8 Series for RMC conduit and EMT conduits. Provide RMC to EMT combination conduit coupling fittings for each end of the expansion fitting.
 - a. Combination expansion/deflection conduit fittings exposed or concealed conduit locations as manufactured by:
 - 1) OZ/Gedney - AXDX Series for RMC conduit.
 - 2) OZ/Gedney - AXDX Series for EMT conduit. Provide RMC to EMT combination conduit coupling fittings for each end of the expansion/deflection fitting.
 - b. Conduit expansion/deflection fittings for FMC and LTFMC conduit.
 - 1) Provide a minimum of 12 inches of "slack" LTFMC in each FMC or LTFMC conduit at building and structure seismic or expansion joint conduit crossings.
 - 2) Note: Each FMC "slack" expansion/deflection location, shall be considered as not less than a 90 degree conduit bend location, for compliance with the maximum quantity of conduit bends allowed in a raceway.
 - 4. Conduit Fitting Bonding Jumper
 - a. The grounding/bonding path of metal conduit shall be maintained by the fitting.
 - b. Provide a bonding jumper at each expansion, deflection and combination expansion deflection conduit fitting.
 - c. The jumper shall be a bare flexible copper "braid". The copper braid electrical current carrying capacity shall be equal to the metal conduit.

- d. Provide a factory terminated ground clamp on each end of the braid with adjusting steel conduit grounding clamps and connect to each respective conduit end.
- e. The jumper braid length shall be eight (8) inches longer than the respective conduit fitting.
- f. Bonding jumper for FMC and EMT fittings as manufactured by:
 - 1) OZ/Gedney - BJ Series
 - 2) Appleton - XJB Series

2.04 CONDUIT BODIES CONDUIT FITTING

- A. Conduit bodies shall provide conductor access with a removable conduit body cover and wiring area enclosed in metal housing. The conduit body shall facilitate pulling conductors.
- B. In-line form "C" conduit bodies shall be prohibited.
- C. The interior space "length" of 90 degree "elbow" conduit bodies shall not be less than 6 times the diameter size of the largest conduit connecting to the conduit body.
- D. Conduit body covers shall be removable, gasketed; watertight "domed" metal covers with threaded screw attachment to the conduit body.
- E. Lubricated, reusable, wire roller guards inside the conduit body shall protect wire from insulation damage during wire "pulling".
- F. Conduit body fittings shall comply with UL 514.
 - 1. For RMC Conduit
 - a. OZ/Gedney - LB 6X/Mogul (90 degree elbow) Series - threaded body.
 - b. Appleton - LB/Mogul (90 degree elbow) Series - threaded body.
 - 2. For EMT Conduit
 - a. Same as for RMC conduit. Provide EMT to RMC conduit combination coupling fitting for each outlet body connection.

2.05 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arnco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - 4. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.06 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Minimum cross section size 4 inches X 4 inches.
- E. Suitable for mounting in any position orientation.
- F. Finish
 - 1. Indoor non-raintight, rust inhibitor phosphatizing base coating and baked enamel finish, manufacturer's standard color.
 - 2. Raintight or outdoor-galvanized metal, with corrosion resistant phosphate primer and baked enamel finish, manufacturer's standard color, NEMA 3R construction.
 - 3. All hardware shall be plated to prevent corrosion.
- G. Construction
 - 1. Minimum metal gauge shall not be less than 14 gauge.
 - 2. Cover shall be hinged entire length of cover. Cover shall be held in the closed position with bolts and nuts.
 - 3. Provide spring nuts on all hardware fastener penetrations into the interior of the wireway to protect against wire insulation damage.
 - 4. The inside of 90-degree corners in the wireway shall be a 45-degree level.
 - 5. Grounding continuity between wireway sections and fittings shall be continuous the entire length of the wireway.

2.07 WALL DUCT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. General
 - 1. All components of the duct assembly shall be manufactured in accordance with the standards of underwriters' laboratories, Inc. Ducts shall be manufactured by Wiremold, Square D or walker.
 - 2. The end of run, duct end, shall have a steel closure plate or duct to conduit adapter (size to match conduit), as applicable.
 - 3. Ducts shall provide a smooth inside surface without sharp projections to protect conductors from damage.
 - 4. Provide longitudinal dividers, horizontal teels, elbows, crosses and circuit isolation tunnels for cross over connections inside the ducts.
- E. Tubs and covers shall be 14 gauge steel roller leveled with a phosphatized baked enamel finish.

- F. Provide trench partitions to maintain separation of high and low potential power systems, signal systems and control system services.
- G. The coverplates shall be a maximum of 2'-0" long. Coverplates shall be held in place by screws.
- H. Vertical elbows shall be an integral part of a coverplate, elbows, offsets, coverplates, grommets, end closures, risers and connectors shall be provided for a complete installation.
- I. The entire duct system shall provide an electrically continuous ground path. Connections between ducts, junction boxes, and conduit fittings shall provide a positive grounding path.
- J. Provide not less than (1) #8 AWG (green THHN) continuous copper ground wire in all duct runs.
- K. All power wire shall be run through power floor duct and shall not be mixed with other systems.
- L. Power wire installed in floor duct shall be #10 (THHN/THWN) minimum or larger as noted on drawing.
- M. Circuit wires shall be tagged with circuit I.D. numbers at each junction point and each service entrance or exit.
- N. Paint wall duct to match wall finish.

2.08 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Prime coating, ready for field painting.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.

2.09 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 4. O-Z/Gedney; a unit of General Signal.
 - 5. Thomas & Betts Corporation.
 - 6. Walker Systems, Inc.; Wiremold Company (The).
- B. Flush or concealed outlet and junction boxes: Pressed steel, hot-dip galvanized, knockout type with conduit entrances sized to match.
- C. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

- D. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- E. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- F. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- G. Metal Floor Boxes: Cast metal, rectangular.
- H. Nonmetallic Floor Boxes: Nonadjustable, round.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- K. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
- L. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
- M. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- N. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
- O. Box extension rings used to accommodate new building finishes shall be of same material as recessed box.
- P. Provide boxes of proper code size for the number of wires or conduits passing through or terminating therein, but in no case shall box be less than 4 inches square by 2 1/8 inch deep, unless specified elsewhere or noted otherwise on the drawings.
- Q. Gangable boxes are allowed.
- R. Boxes installed concrete shall be U.L. approved for installation in concrete, and shall allow the placing of conduit without displacing reinforcing bars.
- S. Provide fixture-supporting device in outlet boxes for surface mounted fixtures as required.
- T. Provide solid gang boxes for three or more switches, for mounting behind a common device plate. Provide barriers for all 277-volt devices where more than one device is installed in an outlet box.

- U. Individual audio/visual telephone, computer or data outlets: 4-11/16" square by 2-1/2" deep minimum with single gang extension ring on flush boxes.
- V. Combination telephone/data or computer outlets: 4-11/16" square by 2-1/2" deep minimum with single gang extension ring on flush boxes.
- W. Surface Outlet Boxes
 - 1. Surface mounted outlet boxes, cast iron Type FS or FD, with threaded hubs as required. Provide plugs in all unused openings. Provide weatherproof gaskets for all exterior boxes.
- X. Floor boxes, cast iron, concrete tight with leveling screws adjustable floor ring, rectangle brass cover and clear polycarbonate carpet flange, minimum floor box clear inside depth not less than 3-inches.
 - 1. Boxes:
 - a. Single gang: Hubbell #B-2436.
 - b. Two gang: Hubbell #B-4233.
 - c. Three gang: Hubbell #B-4333.
 - 2. Covers:
 - a. Pedestal outlet: Hubbell #S-2425.
 - b. Duplex receptacle: Hubbell #S-3825.
 - c. Single system outlet: Hubbell #S-2625.
 - 3. Carpet Flanges:
 - a. Single gang: Hubbell #S-3083.
 - b. Two gang: Hubbell #S-3084.
 - c. Three gang: Hubbell #S-3085.
- Y. PVC Coating
 - 1. Metal outlet and junction boxes installed in outdoor or exposed non-weather protected locations shall be PVC coated.
 - 2. PVC coating shall be factory applied, to comply with NEMA-RN1 and 5-19.
 - 3. The adhesion of the PVC coating to the metal box shall exceed the strength of the coating itself, based on 0.5-inch "strip-pull" test.
 - 4. Uniform coating thickness shall be continuous with out "breaks" or "pinholes" and shall not be less than the following:
 - a. Box exterior surfaces, 40mil. coating thickness.
 - b. Box interior surfaces, 10 mil. coating thickness.

2.10 PULLBOXES AND BOXES

- A. Sizes as indicated on the drawings and in no case of less or material thickness than required by the governing code. Exercise care in locating underground pull boxes to avoid installation in drain water flow areas.
 - 1. General purpose sheet steel pull boxes: Install only in dry protected locations with removable screw covers. Manufacturer's standard baked enamel finish.
 - 2. Weatherproof sheet steel pull boxes: Fabricate of code gauge, hot-dip galvanized steel with gasketed weathertight cover of same material. Manufacturer's standard baked exterior enamel finish.
 - 3. Concrete pull boxes: Furnish complete with pulling irons, hot-dip galvanized traffic cover with hot-dip galvanized frame and 4 galvanized cable racks with porcelain blocks. The box to be set on a pea gravel base 12" thick and as large as the bottom. Install a 3/4" by 10' copper clad ground rod for grounding all metal parts. After cables have been pulled and inspected, seal box between cover and frame with a mastic compound similar to Parmagum or Dukseal. Construction equal to prefabricated pull boxes as manufactured by Quikset or Brooks Products. Refer

to drawings for size. Provide bead weld on cover to pull box to indicate services within pull box (i.e. - "480/277-VOLT, 3-PHASE, 4-WIRE ELECTRICAL" OR "SIGNAL/TEL/P.A./CLOCK/FIRE ALARM").

2.11 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Green.
 - 2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, as indicated for each service.
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
- C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

2.12 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.13 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.14 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by a independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: Rigid steel conduit.
 - 2. Concealed Conduit, Aboveground: EMT.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 - 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit.
Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway.
8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway.
9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: General-use, optical fiber/communications cable raceway.
10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Conduit installation

1. General
 - a. The sizes of the conduits for the various circuits shall be as indicated on the drawings, but not less than the conduit size required by code for the size and quantity of conductors to be installed in the conduit.
 - b. Conduits shall be installed concealed from view. Install conduits concealed in walls, concealed in/below floors and concealed above ceilings, except as specifically noted otherwise.
 - c. The following systems shall be considered as circuits 100 volts and less, all other circuits shall be considered to be over 100 volts (power circuits) unless specifically noted otherwise: Fire alarm, energy management control, telephone, public address, data, computer, television, intercom, intrusion alarm and nurse call.
 - d. Conduits shall be provided complete with conduit bends, conduit fittings, outlet boxes, pullboxes, junction boxes, conduit anchors/supports, grounding/bonding for a complete and operating conductor/wire raceway system.
 - e. Metal and nonmetal conduits shall be provided mechanically continuous between termination connection points. Metal conduit shall be provided electrically continuous between termination connection points.
 - f. Individual conduit paths and home runs shown on the drawings shall be maintained as separate individual conduits for each homerun and path.
 - g. Conduits, conduit fittings and installation work occurring in classified hazardous materials locations shall comply with applicable code Class 1 Division 1 requirements, unless specifically noted otherwise.
 - h. Transitions between conduits constructed of different materials and occurring in above grade locations shall be allowed only at outlet boxes, junction boxes, pull boxes and equipment enclosures unless specifically indicated otherwise. Provide outlet boxes and junction boxes.
 - i. Metal conduit terminating to nonmetal enclosures; terminating into metal enclosures with "concentric.ring" knockouts; terminating into metal

enclosures with knockout reducing washers, including but not limited to equipment housings, outlet boxes, junction boxes, pull boxes, cable trenches, manholes, shall be provided with a ground/bonding lug integrated with the conduit termination conductor fitting construction, by the fitting manufacturer. The lug shall provide for connection of a grounding/bonding conductor (insulated or uninsulated). The grounding lug shall be located on the fitting, inside the termination enclosure.

- j. The type of conduit, type of conduit fittings, and type of conduit supports and method of conduit installation shall be suitable for the conditions of use and conditions of location of installation based on the manufacturer's recommendations; based on the applicable codes and based on the requirements of the contract documents.

D. Minimum Raceway Size: 3/4-inch trade size.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

F. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

G. Do not install aluminum conduits in contact with concrete.

3.02 INSTALLATION

A. General

1. The sizes of the conduits for the various circuits shall be as indicated on the drawings, but not less than the conduit size required by code for the size and quantity of conductors to be installed in the conduit
2. Conduits shall be installed concealed from view. Install conduits concealed in walls, concealed in/below floors and concealed above ceilings, except as specifically noted otherwise.
3. The following systems shall be considered as circuits 100 volts and less, all other circuits shall be considered to be over 100 volts (power circuits) unless specifically noted otherwise: Fire alarm, energy management control, telephone, public address, data, computer, television, intercom, intrusion alarm and nurse call.
4. Conduits shall be provided complete with conduit bends, conduit fittings, outlet boxes, pullboxes, junction boxes, conduit anchors/supports, grounding/bonding for a complete and operating conductor/wire raceway system.
5. Metal and nonmetal conduits shall be provided mechanically continuous between termination connection points. Metal conduit shall be provided electrically continuous between termination connection points.
6. Individual conduit paths and home runs shown on the drawings shall be maintained as separate individual conduits for each homerun and path
7. Conduits, conduit fittings and installation work occurring in classified hazardous materials locations shall comply with applicable code Class 1 Division 1 requirements, unless specifically noted otherwise.

8. Transitions between conduits constructed of different materials and occurring in above grade locations shall be allowed only at outlet boxes, junction boxes, pull boxes and equipment enclosures unless specifically indicated otherwise. Provide outlet boxes and junction boxes.
9. Metal conduit terminating to nonmetal enclosures; terminating into metal enclosures with "concentric.ring" knockouts; terminating into metal enclosures with knockout reducing washers, including but not limited to equipment housings, outlet boxes, junction boxes, pull boxes, cable trenches, manholes, shall be provided with a ground/bonding lug integrated with the conduit termination conductor fitting construction, by the fitting manufacturer. The lug shall provide for connection of a grounding/bonding conductor (insulated or uninsulated). The grounding lug shall be located on the fitting, inside the termination enclosure.
10. The type of conduit, type of conduit fittings, and type of conduit supports and method of conduit installation shall be suitable for the conditions of use and conditions of location of installation based on the manufacturer's recommendations; based on the applicable codes and based on the requirements of the contract documents.

B. RMC Installation Locations

C. RGS, IMC conduits and RGS, IMC fittings shall be installed in the following locations:

1. Embedded in floors, walls, ceilings, roofs, foundations, and footings constructed with concrete.
2. Embedded in walls and foundations constructed with brick and masonry.
3. Interior of buildings, within nine feet of finish floor lines for exposed conduit locations.
4. Exterior of building for exposed conduit locations.
5. Damp or wet locations, exposed or concealed locations.
6. Exposed on roofs.
7. In hazardous materials areas and locations; below hazardous materials areas and locations; above hazardous materials areas and locations.
8. Exposed on utility service poles, for pole risers less than 9 feet above finish grade.
9. RMC conduit and RMC fittings may be installed in any location where EMT and FMC conduit is permitted to be installed.

D. EMT Installation Locations

E. EMT conduit and EMT fittings may be installed in the following locations, for circuit conductors operating below 600 volts to ground; locations containing only "non-hazardous materials"; only dry locations:

1. Concealed in hollow non masonry, metal stud frame and wood stud frame walls.
2. Concealed above ceilings.
3. Exposed inside interior enclosed crawl spaces.
4. Exposed interior locations placed 9 ft. or higher above finished floors.
5. Exposed in the following dedicated function areas, interior enclosed room locations:
 - a. Indoor enclosed electrical equipment rooms and closets.
 - b. Indoor enclosed data and telecommunication terminal rooms and closets.
 - c. Indoor enclosed HVAC equipment rooms and closets.
6. Any location where FMC is described to be installed, except as the final connection to rotating or vibrating equipment.

F. FMC Installation Locations

- G. FMC conduit and FMC fittings may be installed in the following locations normal branch for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”; only dry, interior locations. FMC conduit and FMC fittings are not allowed for emergency branch circuits, including life safety critical or equipment branch circuits and feeders.
1. Concealed in hollow non-masonry metal stud frame and wood stud frame fully enclosed walls.
 2. Concealed above fully enclosed ceiling spaces.
 3. FMC conduit shall be installed in continuous lengths between termination points. FMC shall not be “spliced” or coupled directly to FMC or any other conduit type under any circumstance.
 4. The maximum continuous length of FMC that shall be installed between termination end points is 6 feet. Circuits requiring continuous conduit lengths exceeding 6 feet between termination end points shall be installed using either RMC or EMT conduits. FMC lengths shorter than 16 inches are prohibited.
 5. The minimum size FMC conduit shall be as shown on the drawings but not be less than the following:
 - a. FMC lengths of six feet or less, minimum FMC conduit size shall be 0.50 inches.

H. LTFMC Installation Locations

- I. LTFMC conduit and LTFMC fittings shall be installed in the following locations for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”:
1. Final electrical connection to vibrating or rotating equipment; control and monitoring devices mounted on vibrating and rotating equipment including the following. Minimum conduit length shall not be less than 24 inches:
 - a. Motor, engines, boilers, solenoids, and valves.
 - b. Fixed mounted.
 - c. Fixed mounted food preparation equipment and “kitchen” equipment.
 2. All locations where exposed flexible conduit connections are required, both indoor and outdoor.
 3. Final connection to indoors electrical transformers. Minimum conduit length shall not be less than 24 inches, maximum conduit length shall not exceed 72 inches.
 4. Do not install LTFMC located in environmental air plenums.

J. RNMC Installation Locations

- K. RNMC conduit and RNMC fittings shall be installed in the following locations containing only “non-hazardous material”:
1. Underground, concealed below earth grade, unless specifically noted or specified otherwise.
 2. Exposed on utility service poles, for pole risers at 9 feet or higher above finish grade, schedule 80 PVC only.
 3. RNMC type “EB” conduit(s) shall be concrete encased along the entire length of the conduits for all installation locations.
- L. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

- M. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- N. Complete raceway installation before starting conductor installation.
- O. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- P. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- Q. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- R. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- S. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to RNC, Type EPC-40-PVC or rigid steel conduit before rising above the floor.
- T. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- U. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- V. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- W. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- X. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.

- Y. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- Z. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- BB. Set metal floor boxes level and flush with finished floor surface.
- CC. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified in Division 31 Section "Earth Moving."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment

pad or foundation. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Provide sleeves for raceways and conduit passing through the following construction elements:
 1. Concrete and masonry foundations, floors, walls and slabs.
 2. Lath and plaster walls and ceilings.
 3. Building structures (ie., foundations, walls, floors, ceilings, and roofs) with a fire rating exceeding 20 minutes.
- C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- E. Rectangular Sleeve Minimum Metal Thickness:
 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- F. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

- G. Cut sleeves to length for mounting flush with both surfaces of walls.
- H. Extend sleeves installed in floors 2 inches above finished floor level, except under floor standing electrical equipment. Sleeves shall be flush with wall ceiling foundations and partitions exposed to public view and extend approximately 0.5 inch past penetration in fire rated construction. Sleeves shall be installed at exact penetration locations and angles to accommodate raceway and conduit routings.
- I. Joists, girders, beams, columns or reinforcing steel shall not be cut or weakened. Where construction necessitates the routing of conduit or raceways through structural members, framing or footings, written permission to make such installation shall first be obtained from the OWNER'S REPRESENTATIVE. Such permission will not be granted, however, if any other method of installation is possible.
- J. The layout and design of raceways and conduits located in or routed through masonry or reinforced beams or the OWNER'S REPRESENTATIVE shall review walls before any work is performed. All sleeving shall be accomplished according to the instructions of the OWNER'S REPRESENTATIVE and shall be accepted before any concrete is poured.
- K. Sleeves, raceways and conduit shall be located to clear steel reinforcing bars in beams. Reinforcing bars in walls shall be offset to clear piping and sleeves.
- L. Provide a continuous clearance between the inside of a sleeve and exterior of conduits and raceways passing through the sleeve not less than the following:
 - 1. 0.5 inch clearance except as required otherwise.
 - 2. 1.0 inch clearance through outside walls below grade.
 - 3. 3.0 inch clearance through seismic joints.
- M. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- N. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- O. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- P. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- Q. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- R. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- S. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.
- T. Sleeve Material:

1. In floor construction: Schedule 40 black steel pipe, with upper surface to be sealed watertight.
2. In concrete or masonry walls roofs or ceilings: Schedule 40 black steel pipe. When installed in roofs or outside walls, seal outer surface watertight.
3. In fire rated construction; lath and plaster construction: 24 gauge galvanized iron or steel.
4. Sleeves through waterproof membranes: Cast iron or Schedule 40 steel with flashing clamp device and corrosion resistant clamping bolts. Caulk space between pipe and sleeve and surfaces between sleeve and conduits sealed watertight.

3.06 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.08 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.09 INSTALLATION OF OUTLET AND JUNCTION BOXES

- A. Accurately place boxes and securely fasten to structural members. Where outlets are shown at same location but at different mounting heights, install outlets in one vertical line. Where outlets are shown at same location and mounting height, mount outlets as close together in a horizontal row as possible. Where the outlet boxes for switches and receptacles are shown at the same location and mounting height, mount in common outlet box with barriers between devices. Provide single piece multigang cover plate for close mounted outlet boxes. Where switches are shown on wall adjacent to hinge side of doors, box shall be installed to clear door when door is fully opened.
- B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- C. Flush mounted boxes shall be attached to two studs or structural member by means of metal supports.
- D. Boxes above accessible ceilings shall be attached to structural members. Where boxes are suspended, they shall be supported independently of conduit system by means of

hanger rods and/or preformed steel channels. Boxes shall be supported independently of all piping, ductwork, equipment, ceiling hanger wires and suspended ceiling grid system.

- E. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- F. Surface mounted outlets shall be attached to concrete or masonry walls by means of expansion shields.
- G. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- H. Locate boxes so that cover or plate will not span different building finishes.
- I. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- J. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- K. Set metal floor boxes level and flush with finished floor surface and within adjustable limits of floor ring. Where outlets are shown at same location or adjacent location, use multigang boxes.
- L. Outlet box horizontal and vertical separation unless noted otherwise. Outlet boxes and device outlet rings installed flush in walls shall be horizontally and vertically separated by not less than 24 inches (edge of box to edge of box) from device outlet boxes and rings in common wall surfaces located on the opposite (back) side of the same wall.
 - 1. Where the separation cannot be maintained, provide a solid backing behind the outlet box. The backing shall extend the width of the wall cavity (i.e. between "studs" or masonry cells) behind the box and 12 inches above and below the outlet box centerline. The backing shall consist of 5/8-inch thick gypsum board anchored in place for "stud" wall construction and solid "mortar" to completely fill the outlet box "cell" in masonry construction.
 - 2. In fire rated walls where the separation cannot be maintained, provide fire rated "box-wrap" around each outlet box inside the wall, to maintain the fire rating of wall with the installed outlet boxes.
- M. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.10 WIREWAY INSTALLATION

- A. Wireway hangers shall provide clamp type, hanger rod type, direct bolted bracket type from ceiling or walls as indicated on the drawings and required for field installation locations. Supports shall be installed a minimum of 5 ft. on center.

3.11 GROUNDING (ADDITIONAL REQUIREMENTS)

- A. Grounding shall be executed in accordance with all applicable codes and regulations, both of the State of California and local authorities having jurisdiction.

- B. The neutral of each transformer shall be grounded by individual separate ground conductors in individual conduits as follows:
1. Conductor and conduit shall be grounded to building main ground bus.
 2. Conductor and conduit shall be grounded to nearest available effectively grounded building structural steel member or grounded metal cold water pipe.
- C. The transformer neutral ground conductors for secondary side of the transformers shall be copper and shall be sized according to the following table:
- | | | |
|----|----------------------------|--------------------|
| 1. | Secondary Total Equivalent | Neutral Ground |
| 2. | Size Copper | Wire Size Copper |
| 3. | #2 or smaller | #6-1" conduit |
| 4. | 1 or 1/0 | #4-1" conduit |
| 5. | 2/0 or 3/0 | #2-1 1/4" conduit |
| 6. | 4/0 thru 350 MCM | #1-1 1/4" conduit |
| 7. | Over 350 MCM thru 600 MCM | 2/0-1 1/2" conduit |
| 8. | Over 600 MCM thru 1100 MCM | 3/0-1 1/2" conduit |
| 9. | Over 1100 MCM | 4/0-2" conduit |
- D. Each pull box or any other enclosure in which several ground wires are terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.
- E. The maximum resistance to ground shall not exceed 5 ohms.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.03 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.04 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.05 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high letters on 20-inch centers.
- D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch-wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.03 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.04 FLOOR MARKING TAPE

- A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.05 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

2.06 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.

2. 1/4-inch grommets in corners for mounting.
 3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.07 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.08 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.09 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.
 5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- I. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.
 - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.

- C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- E. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.
- F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- J. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- L. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- M. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- N. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Substations.
 - h. Emergency system boxes and enclosures.
 - i. Motor-control centers.
 - j. Enclosed switches.
 - k. Enclosed circuit breakers.
 - l. Enclosed controllers.
 - m. Variable-speed controllers.
 - n. Push-button stations.

- o. Power transfer equipment.
- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Battery-inverter units.
- s. Battery racks.
- t. Power-generating units.
- u. Monitoring and control equipment.
- v. UPS equipment.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Wall-box motion sensors.
 - 4. Isolated-ground receptacles.
 - 5. Hospital-grade receptacles.
 - 6. Snap switches and wall-box dimmers.
 - 7. Solid-state fan speed controls.
 - 8. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.03 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.04 SCOPE

- A. Work Included: 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 Section, complete as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other sections for work related to those other sections and required to be included as work under this section.
 - 2. General provisions and requirements for electrical work.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.07 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.02 STRAIGHT BLADE RECEPTACLES (SHALL BE UL LISTED HOSPITAL GRADE)

- A. All receptacles in flush type outlet boxes shall be installed with bonding jumper to connect to box to the receptacles ground terminal. Grounding through the receptacle mounting straps is not acceptable. The bonding jumper shall be sized in accordance with the branch circuit protective device as tabulated herein under "Grounding". Bonding jumper shall be attached at each outlet to the back of the box using drilled and tapped holes and washer head screws 6-32 or larger (except isolated ground receptacles). For receptacles in surface mounted outlet boxes direct metal-to-metal contact between receptacle mounting strap (if it is connected to the grounding contacts) and outlet box may be used. Receptacles connected to normal circuits shall be ivory, white or gray as selected by

ARCHITECT. Receptacles connected to emergency (ESSENTIAL) power circuits shall be red.

- B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 8300 (duplex).
 - b. Hubbell; HBL8310 (single), HBL8300H (duplex).
 - c. Leviton; 8310 (single), 8300 (duplex).
 - d. Pass & Seymour; 9301-HG (single), 9300-HG (duplex).
- C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; CR 5253IG.
 - b. Leviton; 5362-IG.
 - c. Pass & Seymour; IG6300.
 - 2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- D. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TR8300.
 - b. Hubbell; HBL8300SG.
 - c. Leviton; 8300-SGG.
 - d. Pass & Seymour; 63H.
 - 2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.03 GFCI RECEPTACLES (SHALL BE UL LISTED HOSPITAL GRADE)

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with UL 498 Supplement SD.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; HGF20.
 - b. Hubbell; HGF8300.
 - c. Leviton; 6898-HG.
 - d. Pass & Seymour; 2091-SHG.

2.04 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Crouse-Hinds.
 - b. EGS/Appleton Electric.
 - c. Killark; a division of Hubbell Inc.

2.05 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; L520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; IG2310.
 - b. Leviton; 2310-IG.
 - 2. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.06 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.07 FLOOR OUTLETS

- A. Flush duplex convenience receptacle in cast iron floor box as hereinbefore specified shall be grounding type, 125 volts, 20 amperes, and shall have two current carrying contacts and one grounding contact which is internally connected to the frame. Receptacle shall be P & S or Hubbell #5342, or Leviton #5014, with standard length mounting strap as required by the manufacturer of floor box being furnished.
- B. Flush floor microphone and projector outlet shall be installed in a cast iron floor box as hereinbefore specified.
- C. Pedestal type duplex convenience receptacle outlet shall be Walker-Parkersburg #513AL-DPS-G except with duplex grounding type receptacle (color as selected by ARCHITECT) as hereinbefore specified. Unit shall be mounted on cast iron floor box as hereinafter specified with proper adapter and nipple for mounting to floor box.
- D. Pedestal type telephone outlet shall be mounted on cast iron floor box as hereinbefore specified and shall be Walker-Parkersburg #407AL, #509AL, or #518AL telephone fitting, finished brush aluminum, complete with proper nipple and adapter for mounting to floor box. The CONTRACTOR shall install the type of outlet at each floor box location as hereinbefore specified as instructed by the Telephone Company engineers.
- E. Pedestal type intercommunicating telephone, P.A. handset or buzzer system outlet shall be mounted on cast iron floor box as hereinbefore specified and shall be Walker-

Parkersburg #501AL, cast aluminum, satin finish, with proper nipple and adapter for mounting to floor box.

2.08 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Provide circuit switches totally enclosed, Bakelite or composition base, toggle type with 277 volt A.C. rating for full capacity or contacts for incandescent or fluorescent lamp loads. Switch ratings shall be 20 ampere only. Switches controlling normal circuits shall be ivory, white or gray as selected by ARCHITECT. Switches controlling circuits connected to emergency (ESSENTIAL) power shall be red.
- C. Where switches are mounted in multiple gang assembly and are operating at 277 volts and/or 277 volts and 120 volts mounted in same outlet box, there shall be a barrier installed between each switch.
- D. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- E. Pilot Light Switches, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 - 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- F. Key-Operated Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
 - 2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- G. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.

2.09 WALL-BOX DIMMERS

- A. Dimmer switches shall be as indicated herein unless specifically noted otherwise on the drawings.
- B. Dimmer cover plate shall be the same color as switch cover plates in the same area.
- C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- D. Four-way switching may be added to first paragraph below after verifying availability with manufacturers.
- E. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- F. Incandescent dimmers shall be used for control of line voltage incandescent light fixtures except "low voltage" type lights. Lutron "Nova-T" series.
 - 1. Dimmer wattage shall be rated 2000 watt unless noted otherwise on the drawings.
- G. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.10 FAN SPEED CONTROLS

- A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
 - 1. Continuously adjustable rotary knob, 5 A.

2.11 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.
 - 2. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..
 - 3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft..
- B. Long-Range Wall-Switch Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
 - 2. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft..

2.12 WALL PLATES

- A. Provide plates for every normal power switch, normal power receptacle, telephone, computer, television and other device outlets. All plates shall be Pass & Seymour Type "SRP" thermoset plastic color shall be ivory, white or gray as selected by ARCHITECT.

Refer to Section 26 "Identification for Electrical Systems" and Section 26 "Medical Facilities" for engraving requirements.

- B. Provide plates for every emergency (ESSENTIAL) power switch, emergency (ESSENTIAL) power receptacle, and other emergency (ESSENTIAL) power device outlets. All plates shall be Pass & Seymour Type "SRP" thermoset plastic color shall be red for emergency (ESSENTIAL) power device outlets. Refer to Section 26 "Identification for Electrical Systems" and Section 26 "Medical Facilities" for engraving requirements.
- C. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 - 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
 - 4. Material for Damp Locations: with spring-loaded lift cover, and listed and labeled for use in "wet locations."
 - 5. Color: Refer to Architectural plans and specifications.
- D. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable cover.

2.13 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

2.14 MULTIOUTLET ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold Company (The).
- B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with manufacturer's standard finish.
- D. Wire: No. 12 AWG.

2.15 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: ivory, white or gray as selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Emergency (ESSENTIAL) Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: Orange.

2.16 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

- A. The front face device cover plates for switches and outlets shall be engraved with the circuit number and connection source equipment name with 1/4" letters, (i.e. "PNL-A #1"; "PNL-AC #42"; etc.) Additionally device cover plates shall also be engraved 1/8" letters with the circuit ampacity and voltage for circuit exceeding 20 ampere or 120 volts. (i.e. PNL-A #6, 8 - 20 AMP 208V 1 Phase; PNL-2B #10 - 30 AMP 120V 1 Phase; etc.) Lettering for normal circuits shall be black lettering for emergency (essential) circuits shall be black.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
 2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
 2. Verify that dimmers used for fan speed control are listed for that application.
 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
 4. Do not break off dimmer cooling fans.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- J. Occupancy Sensor Light Switches
1. Install dimmers within terms of their listing. Installation and location of occupancy sensors shall be in accordance with manufacturers recommendations.
 2. Adjust sensitivity control as required for proper operation and to limit coverage to room controlled. Adjust sensitivity so that persons passing by an open door to the room controlled will not activate the lights and for minimal motion within the room by the occupant will maintain the lights on.
 3. Adjust time delay off for 15 minutes.

3.02 IDENTIFICATION

- A. Comply with Division 26 Section "Medical Facilities."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 2. Test Instruments: Use instruments that comply with UL 1436.
 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight blade convenience outlets in patient-care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..

END OF SECTION

SECTION 26 57 00

MEDICAL FACILITIES

PART 1 GENERAL

1.01 SCOPE

- A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, deliver and installation of the work of this Section, complete as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
 - 1. Examine all other sections for work related to those other sections and required to be included as work under this section.
 - 2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit product data sheets for all outlet boxes, wiring devices, device plates.

PART 2 PRODUCTS

2.01 ROOM REFERENCE GROUND POINT

- A. The room reference ground point shall provide a common reference ground level connection point for the respective room the ground point is installed in.
- B. The ground point shall be flush mounting steel box with #304 stainless steel overlapping trim coverplate. A ground bus with individual ground lugs sized to accommodate each of the grounding/bonding conductors shall be provided in the box, including four (4) spare #10 AWG lugs and one (1) - spare #6 AWG lugs.
- C. Provide a nameplate on cover "room ground point". Isotrol #RGP, Square D #GS120.

2.02 RECEPTACLES (ADDITIONAL REQUIREMENTS)

- A. Receptacles shall be Underwriters Laboratories listed hospital grade.
 - 1. Duplex convenience receptacles shall be heavy duty grounding type 120 volt 15 ampere with two current carrying contacts and one grounding contact which is internally connected to the frame. Outlets shall accommodate standard parallel blade cap and be side wired. Receptacles on normal circuits shall be ivory, white or gray as selected by Architect. Receptacles on emergency (essential) circuit shall be red.
 - a. Hubbell #8200
 - 2. Duplex 20 ampere convenience outlets same as 15 ampere except ampacity shall be used where duplex receptacles is supplied by separate 20-ampere circuit:
 - a. Hubbell #8300
 - 3. Ground fault convenience receptacles provide separate ground fault receptacle at each location indicated on drawings.
 - a. Hubbell #GF8300
- B. Special outlets hospital grade capacities and types shall be as indicated on the drawings.

2.03 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

- A. The front face device cover plates for switches and outlets shall be engraved with the circuit number and connection source equipment name with 1/4" letters, (i.e. "PNL-A #1"; "PNL-AC #42"; etc.) Additionally device cover plates shall also be engraved 1/8" letters with the circuit ampacity and voltage for circuit exceeding 20 ampere or 120 volts. (i.e. PNL-A #6, 8 - 20 AMP 208V 1 Phase; PNL-2B #10 - 30 AMP 120V 1 Phase; etc.) Lettering for normal circuits shall be black lettering for emergency (essential) circuits shall be red.

PART 3 EXECUTION

3.01 GROUNDING (ADDITIONAL REQUIREMENTS)

A. General

1. The drawings do not show all the bonding connection points or conductors runs. Provide all material and work required for a complete system.
2. All conductor raceways both metallic and non-metallic shall have a separate green equipment ground conductor installed in the raceway with the circuit conductors except as described otherwise for isolated power systems. The raceway shall not be used as the only ground return path. The ground conductor in each raceway shall sized as follows:
 - a. Signal circuit conduits one inch and smaller 1#14 AWG.
 - b. Signal circuit conduits larger then one inch. 1#10 AWG.
 - c. Power circuit raceways.
 - d. Feeder, Subfeeders & Branch

| Circuit Protection Size | Minimum Ground Wire Size in each Raceway |
|-------------------------|--|
| 15 Amp | #12 |
| 20 Amp | #12 |
| 30 to 60 Amp | #10 |
| 70 to 100 Amp | #8 |
| 101 to 200 Amp | #6 |
| 201 to 400 Amp | #3 |
| 401 to 600 Amp | #1 |
| 601 to 800 Amp | 1/0 |
| 801 to 1000 Amp | 2/0 |
| 1001 to 1200 Amp | 3/0 |
| 1201 to 1600 Amp | 4/0 |
| 1601 to 2000 Amp | 250 MCM |
| 2001 to 2500 Amp | 350 MCM |
| 2501 to 4000 Amp | 500 MCM |

B. Grounding In Critical Patient Care Areas

1. Grounding in critical patient care areas shall be prepared as follows. Critical patient care areas include but are not limited to:
 - a. Cath Lab
 - b. Interventional radiology
 - c. Patient Holding
2. The grounding system shall provide for a common electrical potential between all metal surfaces in the room for critical care patient functions.
3. All exposed stationary (non portable) metal and structural surface such as equipment tracks, gas pipes, water pipes, HV/AC ducts grills and pipes, door and window framing, conduits etc. shall be bonded to a common room reference ground point or patient reference ground point. The grounding shall be assured by installation of a continuous #10 AWG ground conductor from the closest room grounding point terminal bus to each respective metal part, with connections made by means of approved copper or brass clamps and lugs. The bond wires shall be concealed in walls and ceilings with or without conduit for non-masonry construction and in conduit in masonry construction. Provide a separate ground wire for each such point. Do not loop grounds between various points.
4. After the non-electrical bonding grounds are installed and before the building walls are closed up, a Independent Test Company shall perform tests and provide certified test

reports that all such points do not exceed 0.1 ohm max. level from the main room reference ground. Walls shall not to be closed up until these reports have been reviewed by the Architect.

5. The ground conductors for electrical power branch circuits not connected to isolated power systems shall be installed in the same raceway as the respective branch circuit conductors.
 6. Provide 1"C with 1#4 AWG ground conductor extended from the room reference grounding point terminal bus to the ground bus in each branch circuit power panel serving that room.
 7. Where existing walls are in place contractor shall provide new ground bonding conductors to the room reference ground and patient reference ground as described herein. Contractor may reuse existing continuous bonding conductors in serviceable condition.
 8. A minimum of one room reference grounding point shall be provided in each room containing critical care patients. Additional room reference ground points shall be provided where shown on the plans. These devices shall maintain a common electrical potential between patient ground points. Metal surfaces and isolated power panels.
- C. Grounding in General Patient Care Locations
1. Grounding in general patient care areas supplied from non-power isolated systems shall be prepared as follows. General patient care areas include but are not limited to:
 - a. Non-critical patient care areas
 - b. Non-emergency examination rooms
 - c. Non-emergency x-ray rooms
 - d. general nursing area patient rooms
 - e. non-emergency treatment rooms
 2. Provide ground conductor in same raceway as respective branch circuit phase conductors, back to respective panelboard.

END OF SECTION

SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Trench excavation, backfill and compaction for new underslab water line extensions.
 - 2. Trench excavation, backfill and compaction for new underslab sanitary sewer line extensions.
- B. Related Requirements:
 - 1. Cutting and Removing Concrete Floor Slab: Section 02 41 19.16 Selective Interior Demolition.
 - 2. Underslab Vapor Retarder: Section 07 26 16 Below-Grade Vapor Retarders.
 - 3. Water Piping Installation and Encasement: Section 22 11 16 Domestic Water Piping.
 - 4. Sanitary Waste Piping Installation and Encasement: Section 22 13 16 Sanitary Waste and Vent Piping.

1.02 REFERENCES

- A. Reference Standards: Comply with the following except as otherwise specified in this Project Manual.
 - 1. Soil Compaction Standard: ASTM D698-12e2 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))

1.03 EXISTING CONDITIONS

- A. The Contractor's attention is directed to the possible existence of pipe and other underground improvements that may or may not be shown on the Drawings. All reasonable precautions shall be taken to preserve and protect any such improvements whether shown on the Drawings or not. Where it is necessary to remove and replace or to relocate such improvements in order to prosecute the work, they shall be removed, maintained in operation and permanently replaced by the Contractor at its expense.

PART 2 PRODUCTS

2.01 BACKFILL MATERIAL

- A. Use of Excavated Material as Backfill: The Contractor may backfill with the excavated material provided that such material consists of loam, clay, sand, gravel or other materials that, in the opinion of the Architect, are suitable for backfilling.
- B. Imported Backfill Materials: Whenever the excavated material is not suitable for backfill, the Contractor shall arrange for and furnish suitable imported backfill material which is capable of attaining the required density at its own expense. Contractor shall legally dispose of the excess trench excavation material off Owner's property.
- C. Crushed Rock or Gravel for Pipe Bedding: Where crushed rock or gravel is specified in the bedding detail on the Drawings, the material shall have the following gradations:

| <u>Sieve Sizes</u> | <u>No. 3 Rock & Passing (%)</u> | <u>No. 4 Rock & Passing (%)</u> | <u>ASTM No. 67 & Passing (%)</u> | <u>Squeegee (%)</u> |
|--------------------|-------------------------------------|-------------------------------------|--------------------------------------|---------------------|
| 1-1/2" | 100 | -- | -- | -- |
| 1" | 90-100 | -- | 100 | -- |
| 3/4" | 60-80 | 100 | 90-100 | -- |
| 3/8" | 0-15 | 90-100 | 29-55 | 100 |
| No. 4 | 0-5 | 0-5 | 0-5 | 70-80 |
| No. 8 | -- | -- | -- | 10-25 |
| No.16 | -- | -- | -- | 0-10 |
| No.200 | -- | -- | -- | 0-2 |

Unless otherwise specified, No. 3 rock shall be used for pipes with inside diameters of 27 inches and larger and No. 4 rock shall be used for pipes with inside diameters of 24 inches and less.

- D. Sand Backfill: The sand shall be natural bank sand, graded from fine to coarse, not lumpy or frozen and free from slag, cinders, ashes, rubbish or other objectionable or deleterious material. The sand shall not contain a total of more than 10 percent, by weight, of loam or clay and all material must be capable of being passed through a 3/4-inch sieve. Not more than 5 percent shall remain on a No. 4 sieve.

PART 3 EXECUTION

3.01 PREPARATION

- A. Structure Protection: Temporary support, adequate protection and maintenance of all existing underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at its expense. Any structure that has been disturbed shall be restored upon completion of the Work.

3.02 EXCAVATION SUPPORT

- A. Regulatory Requirements: All excavations shall be properly supported in the manner as required by OSHA Federal Register Vol. 37, No. 243, Sub-part P, Section 1926.652 or as required by state laws and municipal ordinances and as may be necessary to protect life, property, or the Work.
- Contractor's Responsible Person, as defined in 29 CFR, part 1926, shall evaluate the soil exposed in the excavations.
- B. Excavations shall be so braced, sheeted and supported that they will be safe and the floor alongside the excavation will not slide or settle, and all existing construction will be fully protected from damage. If any damage does result to existing construction, the Contractor, at its own expense, shall make the necessary repairs or reconstruction required as directed by the Architect.
- C. Care shall be exercised in the drawing or removing of sheeting, shoring, bracing and timbering to prevent the caving or collapsing of the excavation faces which are being supported.

3.03 DEWATERING

- A. The Contractor shall provide and maintain, at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods that

will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations.

- B. The Contractor shall dispose of the water from the work in a suitable manner without damage to existing construction. No water shall be drained into work built or under construction. Water shall be disposed in such a manner as not to be a menace to the public health.

3.04 TRENCH EXCAVATION

- A. General: Excavation for pipelines, fittings and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the same as shown on the Contract Drawings or as otherwise approved by the Architect.
- B. Trench Width: The overall trench width shall not be more than 16 inches nor less than 12 inches wider than the largest outside diameter of the pipe to be laid therein, measured at a point 12 inches above the top of the pipe, exclusive of branches. Excavating and trenching shall be true to line so that a clear space of not more than 8 inches or less than 6 inches in width is provided on each side of the largest outside diameter of the pipe in place. For the purpose of this section, the largest outside diameter shall be the outside diameter of the bell, on bell and spigot pipe.
- C. Excavation to Grade and Ductile Iron Water Pipe:
 - 1. The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point between bell holes. The finished subgrade shall be prepared accurately by means of hand tools.
 - 2. The subgrade beneath the centerline of the pipe shall be finished to within 0.03 feet of a straight line between pipe joints and all tolerances shall be above the specified grade.
- D. Trenching by Hand: Hand methods for excavation shall be employed in interior locations.

3.05 PIPE FOUNDATION AND SUBGRADE PREPARATION

- A. Trench Bottom for Pipe: The trench bottom shall be graded to provide a smooth, firm and stable foundation at every point throughout the length of the pipe. Should large gravel and cobbles be encountered at the trench bottom or pipe subgrade, they shall be removed from beneath the pipe and replaced with clean imported sand that shall be compacted to provide uniform support and a firm foundation all at the Contractor's expense.
- B. Foundation in Poor Soil: If excessively wet, soft, spongy, unstable or similarly unsuitable material is encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth exposing stable subgrade.

3.06 PIPE BEDDING

- A. General:
 - 1. The pipe shall be carefully bedded as shown on the Drawings. The Contractor shall be responsible for accurately shaping the pipe subgrade to fit the bottom of the pipe for the width shown on the bedding details.
 - 2. Each joint shall be recessed in undisturbed soil or bedding material as required by the bedding detail in such a manner as to relieve the bell of the pipe of all load and to ensure continuous bearing along the pipe barrel upon the pipe subgrade.
 - 3. The pipe bedding, using either selected material, clean, imported sand or crushed rock or gravel, shall be compacted by approved methods to Standard Proctor of 95 percent. When the bedding material is selected material or imported sand, the pipe bedding backfill shall be brought to optimum moisture content and shall be placed by hand in layers not exceeding 3

inches in thickness to the centerline (springline) of the pipe and each layer shall be solidly tamped with the proper tools so as not to injure, damage or disturb the pipe. Backfilling shall be carried on simultaneously on each side of the pipe to ensure proper protection of the pipe.

- B. Sand for Pipe Bedding: Where the trench excavation and pipe foundation and/or subgrade consist of granular soil, the pipe may be bedded in the material found in the trench as hereinafter provided. Clean imported sand shall be used when the trench excavation material and pipe foundation is not granular soil that is suitable for adequate bedding. In all cases, the material to be used for pipe bedding shall be subject to the approval of the Architect.

3.07 BACKFILLING

- A. General:
 - 1. All trenches shall be backfilled after pipe, fittings and appurtenances have been installed, inspected and approved by the Engineer. Whenever a relative compaction requirement value is specified herein, the optimum moisture content and relative density shall be determined in accordance with Standard Proctor Density AASHTO T-99 or ASTM D698.
 - 2. All wood and waste material shall be removed from excavation preparatory to backfilling. Backfill material shall be free of trash, wood, large rock or other objectionable debris. Backfilling shall include the refilling and compacting of the fill in trenches of excavations up to the bottom elevation of the floor slab, or, where indicated on the Drawings, to the bottom elevation of the underslab gravel layer with the underslab vapor retarder. Coordinate with Section 07 26 16.
- B. Procedure at Pipe Zone: Selected backfill material consisting of loose earth or sand free from stones, clods or other deleterious material shall be placed in the trench simultaneously on each side of the pipe for the full width of the trench in layers of about 6 inches in depth. Each layer shall be thoroughly compacted to a Standard Proctor of 95 percent by tamping. Particular attention is to be given to the underside of the pipe and fittings to provide a firm bedding support along the full length of the pipe. Care shall be exercised in backfilling to avoid damage to the pipe. The pipe zone shall be considered to extend 12 inches above the top of the outside diameter of the pipe bell.
- C. Procedure Above Pipe Zone: The remaining portion of the trench shall be backfilled, compacted and/or consolidated by approved methods to obtain a Standard Proctor of 95 percent.
- D. Compaction: Compaction shall be done by use of vibratory equipment, tamping rollers, or other mechanical tampers of the type and size approved by the Architect. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened and compacted to the specified density. Any damage to the pipe as a result of Contractor's operation shall be repaired and/or replaced at the Contractor's expense.

3.08 SITE QUALITY CONTROL

- A. General: See Section 01 45 20.
 - 1. Field Testing: Soil testing during construction will be conducted by acceptable testing laboratory.

- B. Density and Moisture Content Testing: The density and moisture content of each layer of compacted backfill will be determined by the testing agency in accordance with ASTM D1556 or D6938.
- C. Non-Conforming Work:
 - 1. Any material found not to comply with the minimum specified density shall be recompact until the required density is obtained.
 - 2. If, because of unsatisfactory test results it is necessary to retest after corrective works, cost of tests other than initial tests shall be paid by Contractor.

3.09 CLEANING AND WASTE MANAGEMENT

- A. Waste Management: The Contractor shall make the necessary arrangements for and shall remove and legally dispose of all excess excavated material off Owner's property.
- B. Cleaning: After backfill has been completed, sweep floor area around the backfilled trench, leaving interior space clean and ready for installation of concrete floor patch.

END OF SECTION