TECHNICAL SPECIFICATIONS
PROJECT MANUAL

YOLO COUNTY ROADS DEPARTMENT

TENANT IMPROVEMENT

284 W. Beamer Street

Woodland, California

Job No. #22232

County Job No. #WA24-07-5292

100% CD PACKAGE

July 31, 2025

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SECTION 00 01 20

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SECTION 01 23 00

SUMMARY OF WORK

1.1 WORK COVERED BY CONTRACT DOCUMENTS

A. Work of this Contract consists of the renovation of the Yolo County Roads Building into updated Classroom areas and related spaces. Renovation to All Gender accessible restroom updated Break Area, additional Office, and Conditioned Classroom Space, Canopy Carport made solar ready, hardscape, and related work located at 284 West Beamer Street, Woodland, California.

B. The Work specifically includes all work as represented by the Drawings and Specifications issued for construction and subsequent approved revisions and addenda.

C. Provide all labor, equipment, and materials required to provide complete, properly operating, and safe pool and building.
   1. The extent of the Work, as indicated on the Drawings and as described in the Specifications, shall include all that may be reasonably inferred to be required for proper execution or installation of Work and for complete systems.
   2. If certain features are not fully shown or called for on the Drawings, their construction shall be of the same character, quality, and level of performance as for similar conditions that are shown, called for, or reasonably inferred.

D. The Drawings shall be recognized as diagrammatic in nature and not completely descriptive of all requirements for construction. Whatever Work that may be specified and not drawn or drawn and not specified shall be executed as fully as if described in both these ways. And, should any workmanship or material be necessary that is not either directly or indirectly noted in these Specifications or shown on the Drawings but is nevertheless necessary for properly carrying out the obvious intention thereof, Contractor shall understand it to be implied and shall provide for the same as fully as if it were particularly described or delineated.

1.2 DEVIATIONS AND DISCREPANCIES

A. Should the Contract Documents contradict themselves, Contractor shall provide the more stringent or higher quality or quantity, unless otherwise accepted by Owner.

B. Deviations from or discrepancies to the Drawings, Specifications, and/or submittal requirements shall be brought to the immediate attention of Architect in writing with sufficient details to permit proper analysis. This notification shall be made prior to the continuation or performance of any additional work.

1.3 PERMITS AND LICENSES

A. Utility connection fees will be paid for by Owner.

B. Building Permit will be picked-up and paid for by Owner.

C. Contractor shall obtain and pay for all other necessary permits including but not necessarily limited to plumbing, electrical, mechanical, and fire sprinklers.

D. Additional requirements of all parties to the Contract are included in the Contract Forms and Conditions of the Contract.

1.4 DEFERRED APPROVAL AND DESIGN-BUILD ITEMS

A. Permits for Deferred Approval and Design-Build items are the responsibility of the Contractor.
   1. Where Drawings and/or Specifications exist for Deferred Approval and Design-Build items, such Drawings and Specifications represent only a general outline of the work required of the Contractor. The actual scope of work shall be as determined by all entities having jurisdiction.
   2. The Contractor shall verify the scope of work and permits required for all Deferred Approval and Design-Build items with all entities having jurisdiction and shall include all costs associated with such permits and work in the Contractor's fee. If the scope of work required by all entities having jurisdiction is less than or different from the scope outlined in the Contract Documents, the Contractor shall include the greater scope in their fee or bring the discrepancy to the Architect's attention before providing a proposed fee. If the scope of work required by the entities having jurisdiction is greater than the scope outlined in the Contract Documents, the Contractor is responsible for the required scope of work at no additional cost to the Owner.
   3. The Contractor is responsible for obtaining the stamps and signatures of qualified engineers as required by all agencies having jurisdiction over the Deferred Approval and Design-Build items.

B. The Contractor or Contractor's subcontractor shall have a minimum of five years of continuous experience with the type of work included in the Deferred Approval and Design-Build items on projects in the same jurisdiction and of similar type and size to this Project.

C. Deferred Approval items are noted on the Drawings.

1.5 FIELD CONDITIONS

A. Verify existing conditions and proposed dimensions before commencing Work.
   1. Determine dimensions where necessary.
   2. Immediately notify Architect of any discrepancies and, until they are resolved, do not proceed with affected work.

1.6 WORK UNDER OTHER CONTRACTS

A. Concurrent work under other contracts includes but is not limited to:
   1. Work by Owner.
   2. The Contractor shall protect all public spaces outside the tenant lease areas during tenant build out-and during work by Owner.

1.7 HAZARDOUS MATERIALS

A. The Owner has surveyed the existing building and site for asbestos, PCB, lead, and other hazardous materials and has contracted separately to have any asbestos containing materials (ACM) removed. A copy of the survey report is available from the Owner.

B. If any other miscellaneous hazardous materials are encountered during demolition operations, whether identified in the Owner's hazardous materials survey or not, immediately notify the Owner's Representative.

C. Do not disturb any material suspected of containing a hazardous material. The Owner will arrange to have any hazardous materials encountered during demolition removed under separate contract.

1.8 DEFINITIONS

A. The following definitions apply to the language used in these Specifications.
   1. The term "Owner" refers to Ryan Pistochini, Yolo County.
   2. The term "Architect" refers to the firm of Comstock Johnson Architects.
   3. The term "Construction Manager" refers to TBD.
   4. The term "Contractor" refers to the General Contractor, TBD

B. Where the terms, "Plumbing Contractor," "Electrical Contractor," or instances of similar terminology are used, it is for convenience only and shall in no way affect the overall responsibility of the General Contractor.

C. Where the terms "as required" and "required" are used, it shall mean "to meet the Contract Documents, to meet Code requirements, to meet good building practice, to meet the condition prevailing, to meet performance requirements, and to provide complete systems."

D. Where the term "General Conditions" is used, it shall mean "General Conditions of the Contract for Construction." [If the forgoing does not refer to "AIA A201," insert the Owner's General Conditions document title here.]

E. Where the term "Agreement" is used, it shall mean "Agreement between Owner and Contractor." [If known, insert full document title here. AIA has several versions.]

1.9 SPECIFICATIONS AND DRAWINGS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
   2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. The General Conditions, Supplementary Conditions, and Division 01, “General Requirements,” apply to the Work of all Sections.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
   1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
   2. Abbreviations: Materials and products are identified by abbreviations as scheduled on Drawings.

1.10 LISTING OF RELATED WORK

A. Listings of related requirements in the various Sections are not necessarily complete listings. Said listings are provided for information and convenience only and are intended to highlight related or similar work specified in other Sections or on the Drawings.

B. Related work listings and omissions from such listings are not intended to control the Contractor in dividing the Work among subcontractors or in establishing the extent of the Work to be performed by any trade.

1.11 INSURANCE

A. If not previously provided to Owner, Contractor shall submit Certificates of Insurance for Worker's Compensation Insurance and Public Liability and Property Damage Insurance in an amount not less than required by Owner. Owner to be named on the Certificate of Insurance as additional insured.

1.12 CONTRACTOR'S USE OF SITE

A. The following is in addition to the requirements stated in the General Conditions.

B. Contractor shall have limited use of the premises for execution of the Work within limits to be designated by the Owner.

1.13 SUPERINTENDENCE

A. If not already designated, the Contractor shall designate, before starting Work, a Superintendent in accordance with the General Conditions, who shall have complete authority to represent and act for Contractor.
   1. Superintendent shall be acceptable to Owner and Architect.
   2. Superintendent shall be present at the site at all times while Work is actually in progress on the Contract. During periods when Work is suspended, make arrangements acceptable to the Owner for any required emergency work.

B. If such approval is withdrawn by Architect and/or Owner, Contractor shall, as soon as is practicable after having received written notice of such withdrawal, remove Superintendent from the Project and shall not thereafter employ that person as Contractor's Superintendent on the Project. Contractor shall replace Superintendent with another representative acceptable to Owner and Architect as specified above.

1.14 OWNER FURNISHED PRODUCTS

A. Refer to the Agreement" for additional requirements regarding Owner furnished products.]

B. Contractor shall coordinate delivery schedule with Owner.

C. Contractor shall make arrangements with Owner to ascertain required arrangements for warehousing, delivery to Project site, and installation.

D. Contractor shall be responsible for Owner-furnished products when they are delivered to the site or are turned over by the Owner's vendor or distributor.

E. Contractor's warranty for Owner-furnished items shall be limited to installation only.

1.15 OWNER OCCUPANCY

A. The Contractor shall allow, subject to City Woodland approval, the Owner to take possession of and use any completed or partially completed portion of the structures during the progress of the Work as soon as is possible without interference to the Work. Contractor shall not be responsible for damages caused by Owner or others outside of Contractor's control. Inspect areas to verify existing conditions prior to Owner's occupancy.

B. Possession, use of structure or Work, and placing and installation of equipment by Owner shall not in any way evidence the completion of the Work or any part of it.

END OF SECTION

SECTION 01 45 20

CONCRETE MOISTURE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Testing for Moisture Vapor Emission Rate (MVER), relative humidity, and alkalinity at concrete floors scheduled to receive applied floor coverings.

B. Related Requirements:
   1. Cast-In-Place Concrete: Section 03 30 00.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
   1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00 “Submittal Procedures.”

1.3 INFORMATIONAL SUBMITTALS

A. Qualifications of personnel or laboratory to perform testing.

B. Results of substrate moisture testing for each location and maximum allowable levels specified in respective Specification Sections for the intended floor finish.

1.4 FIELD CONDITIONS

A. Ambient Conditions:
   1. Area to be tested shall match that of the finished floor covering.
   2. Spaces shall be conditioned to temperature and humidity levels expected for final Owner occupancy or as follows:
      a. Interior temperature shall be 75 degrees F, plus or minus 10 degrees F.
      b. Relative humidity shall be 50 percent, plus or minus 10 percent.
   3. Maintain the above conditions for 48 hours prior to and throughout the duration of the tests.

PART 2 - PRODUCTS

2.1 MATERIALS FOR TEST PROCEDURES

A. Alkalinity Tests: Test kit by American Moisture Test, Inc., Irvine, CA, Taylor Tools, or equal pH meter.

B. MVER Tests:
   1. Calcium Chloride Test Kits: Pre-packaged and of commercial consistency; American Moisture Test, Inc., Irvine, CA, Taylor Tools, or equal. Kit shall include sealed dish of anhydrous calcium chloride, a metering dome with gasket, and instructions.
   2. Relative humidity (RH) probe that has been verified for accuracy within the past year.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean concrete surfaces of any residues resulting from pour of concrete which will affect the moisture vapor drive.

B. Plastic dome of test kit shall be sealed airtight to prevent ambient humidity from influencing the test results.

3.2 TESTING

A. General:
1. Perform moisture tests based on the Moisture Vapor Emission Rate (MVER) content in accordance with ASTM F1869, relative humidity tests in accordance with ASTM F2170, and alkalinity tests in accordance with ASTM F710, on concrete subfloors. Results of these tests will be used to determine suitability of substrate to receive flooring materials.
2. Number of tests shall be determined by the square footage of each flooring material. Provide minimum of three tests for the first 1,000 square feet (93 square meters), and one test kit per each additional 1,000 square feet (93 square meters), with consideration to separation of test areas.
3. Results of these tests will be used to determine suitability of substrate to receive flooring materials.
4. Unless otherwise approved in writing by Owner Representative, tests shall be performed by an independent testing agency.

B. MVER Test Kit:
1. Verify temperature of slab is up to service temperature.
2. Duration of MVER test shall be 60 to 72 hours.
3. Dish shall be measured one-hour before and one-hour after testing with weight calculated within 0.1 grams.
4. Where calcium chloride test results are satisfactory but there is reason to suspect that unacceptable moisture levels below the upper two centimeters of the concrete may still exist, a relative humidity probe shall be used to test the full depth of the slab.

C. RH Probe:
1. Verify concrete slabs are up to service temperature at least 48 hours prior to testing.
2. Depth of probes shall be 40 percent on slabs drying from the top only and 20 percent for slabs drying from both sides.
3. Probe shall be allowed to acclimate and checked for drift less than 1 percent relative humidity over a 5 minute period.
4. Elapsed time for test shall be 48 hours.

3.3 INSTALLATION OF CONTROL MATERIALS

A. Where tests are not satisfactory and substrates exceed the moisture vapor and alkalinity limits required by floor material manufacturers, do not proceed with installation. Notify Owner Representative for review of conditions and to determine a resolution acceptable to the Owner including application of a topical barrier coat as specified in Section 07 26 20 “Concrete Vapor Emission Control.”

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Partial demolition of the interior of a building undergoing alterations as indicated on the Drawings, and for the removal, salvage, or reuse of materials in new construction.
2. Patching and repairs.
3. Hazardous materials abatement.

B. Related Requirements:
1. Summary of Work: Section 01 11 00; for use of the building and phasing requirements.
2. Construction Facilities and Temporary Controls: Section 01 50 00; for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures for selective demolition operations.
3. Cutting and Patching: Section 01 73 29; for cutting and patching procedures for selective demolition operations.
4. Contract Closeout: Section 01 77 00; for record document requirements.
5. Gypsum Board: Section 09 29 00; for material and construction requirements for temporary enclosures.
6. Division 23 Sections for cutting, patching, or relocating mechanical items.
7. Division 26 Sections for cutting, patching, or relocating electrical items.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Submit for temporary shoring and bracing of the existing Building.
1. Drawings and calculations shall be signed and sealed by a California licensed civil or structural engineer responsible for their preparation and retained by the Contractor.
2. Submittals will be reviewed by the Owner Representative for general conformance with the design intent of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. Construction Waste Management: Manage construction waste in accordance with provisions of Section 01 74 50 “Construction & Demolition Debris Recovery Plan.”

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials and work involving alterations to existing construction shall conform to requirements of applicable Sections of the Specifications.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 03 10 00

CONCRETE FORMWORK AND ACESSORIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all work of this section.

1.2 SCOPE

A. Design, furnish and install forms for concrete as indicated on drawings and specified here. Remove forms and shores at specified time. Clean up.

1.3 RELATED WORK (SEE ALSO TABLE OF CONTENTS)

A. Rough Carpentry: Section 06 10 00.

B. Structural Steel: Section 05 12 00.

C. Metal Fabrications: Section 05 50 00.

D. Items relating solely to mechanical or electrical work are included under those Divisions, except as specifically indicated otherwise on Drawings.

E. Reinforcing Steel: Section 03 20 00.

F. Cast In Place Concrete: Section 03 30 00.

1.4 QUALITY ASSURANCE

A. General:
   1. Conform to all requirements of ACI 347 and CBC Section 1906.1 and 1906.2.
   2. Concrete formwork shall be designed and constructed to safely support fluid concrete and superimposed construction loads without excessive deflection or concrete leakage. Provide bracing to maintain accurate alignment and to resist all anticipated lateral loads. Forms shall conform with drawings as to shape, line, and dimension. Design, engineering and construction of forms shall be Contractor's responsibility. Formwork for exposed concrete shall be constructed to tolerances indicated in ACI 303R.
   3. Cooperate and coordinate with other trades who furnish and/or install piping, conduit, reglets, anchors, inserts, sleeves, hangers, etc., as their work requires; including provisions for recesses and chases.

B. Submittals: (Submit under provisions of Section 01 33 00)
   1. Product Data. Provide manufacturers data and installation instructions for the following:
      a. Tie rods and spreaders.
      b. Formwork for exposed concrete.
      c. Form coatings and release agents.

C. C. Standards and References: (Latest Edition unless otherwise noted)
1. 2022 California Building Code (CBC).
2. "Recommended Practice for Concrete Formwork", ACI 347, American Concrete Institute, latest edition.
3. Standard Grading and Dressing Rules #17, West Coast Lumber Inspection Bureau (For Douglas Fir Form Lumber).
4. U.S. Product Standard PS 1 83 (For Plywood Form Lumber).
5. “Guide to Cast-In-Place Architectural Concrete Practice”, ACI 303R, American Concrete Institute, latest edition.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Form Material:
1. Smooth Concrete exposed to view: 5/8 inch minimum APA Plyform or steel.
2. Concrete concealed from view: 5/8 inch minimum APA Plyform, steel or clean and sound 1 x 8 Standard Grade Douglas Fir.
3. Exposed exterior Concrete Stem Walls: 5/8 inch minimum MDO (Medium Density Overlay) Plyform - Concrete Form Panels or steel.

B. Fiber Forms: Tubular column forms spirally constructed of laminated plies of fiber. Plies shall be laminated using a non-water sensitive adhesive and surface wax impregnated for moisture protection. Forms shall give a smooth and seamless appearance to the cast concrete. Provide reveals, as shown on the drawings, as supplied by the form manufacturer. Forms shall be as manufactured by Sonoco Products, plastic lined; Burke Smoothtube by Burke Co.; or approved equal.

C. Form Clamps: Assembly to have cone washers, (1 inch break back) 3/8” inch center rod.

D. Form Ties:
1. Concrete exposed to view: Snap ties allowing full 1 inch break back.
2. Concrete concealed from view: Snap ties or wire.
3. Verify special spacing requirements with architectural drawings at exposed concrete.

E. Spreaders: Metal (no wood).

F. Form Coating: Non-grain and non-staining types of form coating that will not leave a residual matter on the face of the concrete or adversely affect proper bonding of any subsequent paint or other surface applications.
1. Form coating containing mineral oils or other non-drying materials will not be permitted for any concrete work.

G. G. Joint Tape: No. 471 plastic film tape 3 inches wide, as manufactured by the Industrial Tape Division of 3M Company.

H. H. Expansion Joint Filler (Preformed): ½ inch thick; Flexcell by Celotex Corporation, Elastic Fiber Expansion Joint by Phillip Carey Mfg. Co., or Sealtight Fiber Expansion Joint by W.R. Meadows, Inc.

I. Extruded Polystyrene Foam: ASTM C578 type IV. Dow Chemical Corp. "Styrofoam", UC Industries "Foamular", or approved equal.

PART 3 - EXECUTION

3.1 FORM CONSTRUCTION

A. Construct substantial forms to the shapes, lines, grades and elevations shown, sufficiently tight to prevent leakage of mortar, and tied, clamped and braced to prevent spreading, shifting or settling. Plywood joints shall be square and tight; plywood shall be arranged in such manner as to minimize number of joints and to provide a smooth, attractive finished concrete surface.

B. Apply form coating to forms before reinforcing steel is in place.

C. Sleeves, anchors and bolts, including those for angle frames, supports, ties and other materials in connection with concrete construction, shall be secured in position before the concrete is placed.

D. Proper provisions shall be made for openings, blockouts, sleeves, offsets, sinkages, recesses and depressions required by other trades and suppliers prior to placing concrete.
1. The Contractor shall also see that sleeves have been installed and other provisions have been made for the installation of mechanical, electrical and other equipment.
2. Coordinate with all trades to insure proper placement of all items in forms and to provide proper blockouts wherever required.

E. Concrete work out of alignment, level or plumb will be cause for rejection of the whole work affected and, if so rejected, such work shall be removed and replaced, as directed by Architect, with no additional cost to the Owner.

F. Form Not Required: Concrete footings may be poured directly against cut earth where feasible and when the Architect’s approval has been obtained.
1. See structural drawings for requirements for placing concrete footings directly against earth without forms.

G. G. Use ¾ inch minimum wood chamfer strips typical at all exposed corners unless noted otherwise on drawings.

3.2 CLEANING OF FORMS

A. All dirt, chips, sawdust, rubbish, water, etc. shall be completely removed from form by water hosing and air pressure before any concrete is deposited therein. No wooden ties or blocking shall be left in concrete except where indicated for attachment of other work.

B. Thoroughly clean and patch all holes in formwork and re-coat as required before reusing. Forms not suited to obtain concrete surfaces and tolerances in conformity with Contract requirements will be rejected by Architect.
1. Reuse of forming materials shall be limited only as required to produce the finishes as specified, free from blemishes and other defects unless covered by other building materials in which case blemish free concrete is not required.

3.3 INSPECTION OF FORMS

A. Notify the Architect at least 48 hours in advance of the beginning of pouring operations and at the completion of formwork and location of all construction joints. An inspection of forms and joints will be made for approval of finished work and general layout only. The foregoing inspection shall in no way relieve the Contractor of responsibility of design and safety or formwork, bulkheads and shorings.

3.4 REMOVAL OF FORMS AND SHORING

A. Do not remove forms until concrete has attained sufficient strength to support its weight and any construction loading. Concrete must be allowed to cure long enough to avoid damage during form removal. Contractor or his representative in charge of concrete construction shall be present during removal of forms and shores, and shall be personally responsible for safety of this operation at all times and under all conditions.

B. As a minimum, formwork and shoring shall remain in place for the following periods:
1. Concrete on grade: 24 hours
2. Walls and Columns: 3 days
3. Formwork may be removed and reshores installed before the times indicated above, provided the concrete has cured sufficiently to avoid damage when formwork is removed. Shores must be immediately replaced with reshores in a sequence designed to avoid inducing stress in the concrete member.

3.5 ADJUSTING AND CLEANING

A. Upon completion of this Work, clean up and remove from Site all equipment and debris resulting from this work.

B. Surfaces to be painted shall be smooth and free of substances such as dirt, wax, excessive latence, grease or materials that would prevent proper bonding of finishes.
1. Removal of foregoing contaminants, and complete removal of parting and curing compounds affecting proper paint bond, shall be responsibility of this Section of Work. Sandblast cleaning shall not be employed without specific approval of Structural Engineer.

END OF SECTION

SECTION 03 20 00

REINFORCING STEEL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all work of this Section.

1.2 SCOPE

A. Unless noted otherwise, furnish and install reinforcing for all concrete, including dowels, chairs, spacers, bolsters, etc., necessary for supporting and fastening reinforcement in place as shown on the Drawings and specified herein.

1.3 RELATED WORK (SEE ALSO TABLE OF CONTENTS)

A. Concrete Formwork: Section 03 10 00.

B. Cast-In-Place Concrete: Section 03 30 00.

C. Concrete Unit Masonry: Section 04 22 00.

1.4 QUALITY ASSURANCE

A. General:
   1. Acceptable Manufacturers: Regularly engaged in the manufacture of steel bar and welded wire fabric reinforcing.
   2. Installer Qualifications: Installation shall be done only by an installation firm normally engaged in this business. All work shall be performed by qualified mechanics working under an experienced supervisor.
   3. Welding Qualifications: Welding procedures, welding operators and welders shall be qualified in accordance with AWS D1.4 - "Structural Welding Code Reinforcing Steel".
      a. Welders whose work fails to pass inspection shall be re-qualified before performing further welding.
   4. Reinforcement Work shall conform to ACI 301 and CBC Section 1907, as minimum standards.
   5. Allowable Tolerances:
      a. Fabrication:
         1) Sheared length: 1 inch.
         2) Depth of truss bars: Plus 0 minus ½-inch.
         3) Ties: Plus or minus ½-inch.
         4) All other bends: Plus or minus 1 inch.
      b. Placement:
         1) Concrete cover to form surfaces: Plus or minus ¼-inch.
         2) Minimum spacing between bars: Plus or minus ¼-inch.

3) Crosswise of members: Spaced evenly within 2 inches of stated separation.
4) Lengthwise of members: Plus or minus 2 inches.

c. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 2 bar diameters.

B. Standards and References: (Latest Edition unless otherwise noted):
1. American Concrete Institute (ACI).
a. ACI 301 - "Specifications for Structural Concrete for Buildings".
b. ACI 315 - "Details and Detailing of Concrete Reinforcing".
c. ACI 318 – “Building Code Requirements for Reinforced Concrete”
2. American Society for Testing and Materials (ASTM).
a. ASTM A82 - "Cold Drawn Wire for Concrete Reinforcement".
b. ASTM A185 - "Welded Steel Wire Fabric for Concrete Reinforcement".
c. ASTM A615 - "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement".
d. ASTM A706 – “Low Alloy Steel Deformed Bars for Concrete Reinforcement”.
3. Concrete Reinforcing Steel Institute (CRSI) - "Manual of Standard Practice".
4. 2022 California Building Code (CBC)

C. Submittals: (Submit under provisions of Section 01 33 00)
1. Shop Drawings: Prepare in accordance ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars and shapes, dimensions and details of bar reinforcing and assemblies. Correctness of all reinforcing requirements and work is the responsibility of Contractor. Identify such shop drawings with reference thereon to sheet and detail numbers from Contract Drawings.
a. Do not use scaled dimensions from Contract Drawings in determining the lengths of reinforcing bars.
b. No reinforcing steel shall be fabricated without approved shop drawings.
c. Any deviations from the contract documents must be clearly indicated as a deviation on the shop drawings.
d. Areas of high congestion, including member joints and embed locations shall be fully detailed to verify clearances and assembly parameters and coordination with other trades.
2. Certified mill test reports of supplied reinforcing indicating chemical and physical analysis. Tensile and bend tests shall be performed by the mill in accordance with ASTM A615.
3. Product Data:
a. Manufacturer's specifications and installation instructions for splice devices.
b. Bar Supports.
4. Certificates of Compliance with specified standards:
a. Reinforcing bars.
b. Welded wire fabric.
c. Welding electrodes.
5. Samples: Only as requested by Architect.

D. Tests and Inspections:
1. A testing program is required prior to start of construction. Testing program to be done in compliance with the 2022 CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.

2. All reinforcing steel whose properties are not identifiable by mill test reports shall be tested in accordance with ASTM A615. One Series of tests for each missing report to be borne by the Contractor.
3. When inspections are indicated for reinforcement placement on the Structural drawings, a special inspector shall be employed to inspect reinforcing placement per CBC Section 1704.
4. When tests are indicated for reinforcing steel on the structural drawings, the reinforcing steel used shall be tested in accordance with ASTM A615. One tensile and one bend test for each 2-1/2 tons of steel or fraction thereof, shall be made.
5. Inspect shop and field welding in accordance with AWS D1.4, including checking materials, equipment, procedure and welder qualification as well as the welds. Inspector will use non-destructive testing or any other aid to visual inspection that he deems necessary to assure himself of the adequacy of the weld.
6. Tests and inspection shall be performed by Owners testing agency except when needed to justify rejected work, in which case the cost of retests and reinspection shall be borne by the Contractor.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver reinforcement to project site in bundles marked with metal tags indicating bar size and length.

B. Handle and store materials to prevent contamination.
1. Store reinforcement in a manner that will prevent excessive rusting or coating with grease, oil, dirt, and other objectionable materials. Storage shall be in separate piles or racks so as to avoid confusion or loss of identification after bundles are broken.

C. Deliver and store welding electrodes in accordance with AWS D12.1.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcement Bars: ASTM A615, Grade 60 for all bars.
1. Bar reinforcement to be welded shall meet chemical requirements of ASTM A706.
2. Longitudinal reinforcement in column and beams of special moment-resisting frames shall meet the chemical requirements of ASTM A706.

B. Stirrups and Ties: ASTM A615, Grade 60 for all bars.

C. Steel Dowels: Same grade as bars to which dowels are connected.

D. Welded wire Fabric: ASTM A185.

E. Tie Wires: FS-QQ-W-461, annealed steel, black, 16 gauge minimum.

F. Welding Electrodes: AWS D1.4, low hydrogen, E70XX series.

G. Bar Supports:
1. Typical, unless noted otherwise; CRSI Class 2 wire supports.
a. Do not use wood, brick or other objectionable materials.

b. Do not use galvanized supports.

2. Supports placed against ground: Pre-cast concrete blocks not less than 4 inches square with embedded wire.

H. Mechanical Couplers: Comply with ACI 318 section 12.14.3.

PART 3 - **EXECUTION**

3.1 FABRICATION

A. Shop fabricate reinforcement to meet requirements of Drawings.

B. Fabricate reinforcement in accordance with the requirements of ACI 315 where specific details are not shown or where Drawings and Specifications are not more demanding.

C. Steel reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the Drawings shall not be used. Heating of bars for bending will not be permitted.

D. Reinforcing shall not be field bent or straightened without structural engineer's review.

E. Provide offsets in rebar (1:6 maximum) where required to maintain clearances.

3.2 CONDITION OF SURFACES

A. Examine surfaces and conditions receiving or affecting the work. Do not proceed until unsuitable conditions have been corrected.

3.3 GENERAL

A. Concrete shown without reinforcing shall be reinforced as similar parts shown with reinforcing except where concrete is specifically noted to be unreinforced.

3.4 PLACEMENT

A. All reinforcement shall be accurately set in place, lapped, spliced, spaced rigidly and securely held in place and tied with specified wire at all splices and crossing points. All wire tie ends shall point away from the form. Carefully locate all dowel steel to align with wall and column steel.

1. Bars shall be in long lengths with laps and splices as shown. Offset laps in adjacent bars. Place steel with clearances and cover as shown. Bar laps shall be as indicated on the Drawings. Tie all laps and intersections with the specified wire.
2. Maintain clear space between parallel bars not less than 1-1/2 times nominal diameter, but in no case shall clear space be less than 1-1/2 times maximum size concrete aggregate.
3. Reinforcing dowels for slabs shall be placed as detailed. Sleeves may be used if reviewed by the Structural Engineer before installation. Install dowel through all construction and expansion joints for all slabs on grade.

B. Bar Supports: Support and securely fasten bars with chairs, spacers and ties to prevent displacement by construction loads or placement of concrete beyond the tolerances specified. Conform to CRSI as a minimum standard.

C. Steel Adjustment:
1. Move within allowable tolerances to avoid interference with other reinforcing steel, conduits, or embedded items.
2. Do not move bars beyond allowable without concurrence of Structural Engineer.
3. Do not heat, bend, or cut bars without concurrence of Structural Engineer.
4. Reinforcement shall not be bent after being embedded in hardened concrete.

D. D. Splices:
1. Splice reinforcing as shown.
2. Lap Splices: Tie securely with wire to prevent displacement of splices during placement of concrete.
3. Splice Devices: Install in accordance with manufacturer's written instructions. Obtain Structural Engineer’s review before using.
4. Do not splice bars except at locations shown without concurrence of Structural Engineer.
   a. Where splices in addition to those indicated are required, indicate location on shop drawings clearly and highlight "for Engineer’s approval".

E. Welding:
1. Welding is not permitted unless specifically detailed on Drawings or approved by Engineer.
2. Employ shielding metal-arc method and meet requirements of AWS D1.4.
3. Welding is not permitted on bars where the carbon equivalent is unknown or is determined to exceed 0.55.
4. Welding shall not be done within two bar diameters of any bent portion of a bar which has been bent cold.
5. Welding of crossing bars is not permitted.

F. Welded Wire Fabric: Install in long lengths, lapping 24 inches at end splices and one mesh at side splices. Offset laps in adjacent widths. Place fabric in approximately the middle of the slab thickness unless shown otherwise on the Drawings by dimension. Wire tie lap joints at 12-inch centers. Use concrete blocks to support mesh in proper position.

G. Reinforcement shall be free of mud, oil or other materials that may reduce bond at the time concrete is placed. Reinforcement with tightly adhered rust or mill scale will be accepted without cleaning provided that rusting has not reduced dimensions and weights below applicable standards. Remove loose rust.

H. H. Protection against rust:
1. Where there is danger of rust staining adjacent surfaces, wrap reinforcement with impervious tape or otherwise prevent rust staining.
2. Remove protective materials and clean reinforcement as required before proceeding with concrete placement.

I. Drawing Notes: Refer to notes on Drawings for additional reinforcement requirements.

J. Mechanical and Electrical Drawings: Refer to Mechanical and Electrical Drawings for formed concrete requiring reinforcing steel. All such steel shall be included under the work of this Section.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all Work of this Section.

1.2 SCOPE

A. Furnish, place and finish cast in place concrete and related work as indicated on the Drawings and specified here.
   1. Install miscellaneous metal and other items furnished by other trades to be installed in concrete work.
   2. Provide facilities for job curing of test cylinders and transporting to Testing Laboratory.

B. Provide grouting of steel base plates as indicated on the Drawings and specified here.

1.3 RELATED WORK (SEE ALSO TABLE OF CONTENTS)

A. Concrete Formwork: Section 03 10 00.

B. Reinforcing Steel: Section 03 20 00.

C. Mortar and Grout: 04 05 00.

D. Structural Steel: Section 05 12 00.

E. Metal Decking: Section 05 30 00.

F. Metal Fabrications: Section 05 50 00.

1.4 QUALITY ASSURANCE

A. Standards and References: (Latest Edition unless otherwise noted)
   1. 2022 California Building Code (CBC).
   2. American Concrete Institute (ACI)
      a. ACI 117 Standard Tolerances for Concrete Construction and Materials
      b. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
      c. ACI 211.2 Standard Practice for Selecting Proportions for Structural Lightweight Concrete
      d. ACI 301 Structural Concrete for Buildings
      e. ACI 302 Guide for Concrete Floor and Slab Construction
      f. ACI 305R Hot Weather Concreting
      g. ACI 318 Building Code Requirements for Reinforced Concrete
      h. ACI 360 Design of Slabs-On-Ground
   3. American Society For Testing And Materials (ASTM)

a. ASTM C 31 Making and Curing Concrete Test Specimens in the Field
b. ASTM C 33 Concrete Aggregates
c. ASTM C 39 Compressive Strength of Cylindrical Concrete Specimens
d. ASTM C 42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
e. ASTM C 94 Ready-Mixed Concrete
f. ASTM C 109 Test of Hydraulic Cement Concrete
g. ASTM C 143 Slump of Hydraulic Cement Concrete
h. ASTM C 150 Portland Cement
i. ASTM C 172 Sampling Freshly Mixed Concrete by the Volumetric Method
j. ASTM C 192 Making and Curing Concrete Test Specimens in the Laboratory
k. ASTM C 260 Air-Entraining Admixtures for Concrete
l. ASTM C 330 Lightweight Aggregates for Structural Concrete
m. ASTM C 494 Chemical Admixtures for Concrete
n. ASTM C 618 Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
o. ASTM C685 Volumetric Batching and continuous mixing
p. ASTM C1157 Hydraulic-Cement

B. Submittals: (Submit under provisions of Section 01 33 00)
1. Concrete mix designs. See “Mix Design” below. Include results of test data used to establish proportions.
2. Certificates of Compliance from Manufacturer
a. Cement certificates
b. Aggregates
c. Admixtures.
3. Data regarding hardeners and sealers.
4. Grout samples for sacked surface textures and colors upon Architects request only.
5. Layout drawings for construction, control and expansion joints.
6. Transit-mix delivery slips:
a. Keep record at the job site showing time and place of each pour of concrete, together with transit-mix delivery slips certifying contents of the pour.
b. Make the record available to the Architect for his inspection upon request.
c. Upon completion of this portion of the work, deliver the record and the delivery slips to the Architect.
7. See Section 03 21 00 for reinforcing steel submittals.

C. Tests and Inspections:
1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the 2022 CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
2. The following tests shall be made by a recognized testing laboratory selected by the Owner and approved by the governing agency. All tests shall be in accordance with the previously mentioned standards and ACI 318 Section 5.6. A complete record of all tests and inspections shall be kept.
a. Compressive Strength: Make and cure in accordance with ASTM C-31. Test in accordance with ASTM C-39 and ACI 318 section 5.6.
1) A record shall be made of time and of locations of concrete from which samples were taken.
2) Four identical cylinders shall be taken from each pour of 150 cubic yards or 5000 square feet or part thereof, being placed each day per ACI 318

5.6.2.1. One cylinder shall be tested at age 7 days, and two at age 28 days unless otherwise specified. Preserve remaining cylinder for future use.

b. Drying Shrinkage: (applies to lightweight concrete only unless noted otherwise)
   1) A record shall be made of time cylinders and of locations of concrete from which samples were taken.
   2) Three identical 4" x 4" x 11" specimens shall be made from same concrete as used in structure. Percent of shrinkage shall be reported at 21 days after 7 day moist curing period. Average results of 3 specimens shall be used as the accepted value. The value for laboratory cast specimens shall not exceed .075%. If field test specimens are used in lieu of laboratory specimens, a tolerance of +33% may be used.
   3) Test specimens in accordance with ASTM C157.

c. Concrete consistency (slump) shall be tested in accordance with ASTM C143.

3. Provide full time inspection during the taking of test specimens and during the placing of all concrete and embedded steel.
4. See Section 03 21 00 for reinforcing steel tests and inspections.
5. Provide concrete batch plant inspections per ASTM C685.

PART 2 – PRODUCTS

2.1 MATERIAL

A. Portland Cement: ASTM C 150, Type I or Type II. One brand of cement shall be used throughout to maintain uniform color for all exposed concrete.

B. Concrete Aggregate: Fine and coarse aggregates shall be regarded as separate ingredients. Each size of coarse aggregate, as well as combination of sizes when two or more are used, shall conform to grading requirements of appropriate ASTM Standards and ACI 318.
   1. Concrete Aggregates for Standard Weight Concrete: ASTM C 33. Aggregate shall be crushed granite or Perkins type.
   2. Concrete Aggregates for Lightweight Concrete: ASTM C330 to produce concrete weighing no more than 115 pcf at 28 days. Aggregate shall be vacuum saturated expanded shale as produced through the rotary kiln method.

C. Water: Clean and free from injurious amounts of oil, acids, alkali, organic matter and other deleterious substances; suitable for domestic consumption.

D. Admixtures shall be subject to prior approval by the Architect, in accordance with ACI 318, Calcium Chloride is not permitted.
   1. Water Reducing
      a. ASTM C494 Type A - for use in cool weather.
      b. ASTM C494 Type D - for use in hot weather.
   2. Air Entraining
      a. Conform to ASTM C 260
   3. Fly Ash
      a. Conform to ASTM C 618
   4. Mid-Range Water-Reducers
      a. Master Builders “Polyheed” or approved equal.
   5. Fly Ash Pozzolan
      a. Conforming to ASTM A-618 Class F

E. Slab on Grade Vapor Retarder

1. Vapor Retarder must have the following qualities:
   a. 15 mil thickness minimum
   b. WVTR less than 0.008 as tested by ASTM E 96
   c. ASTM E 1745 Class A (Plastics)
2. Vapor Retarder Products
   a. Stego Wrap Vapor Retarder by STEGO INDUSTRIES LLC.
   b. W.R. Meadows Premoulded Membrane with Plasmatic Core.
   c. Zero-Perm by Alumiseal.
3. Vapor Retarder Tape
   a. Water Vapor Transmission Rate :ASTM E 96, 0.3 perms or lower
   b. Minimum 8-mils thick
   c. Minimum 4 inches wide
   d. Manufactured from High Density Polyethylene
   e. Pressure Sensitive Adhesive

F. Sand: Clean, dry, well graded.

G. Abrasive aggregate for non-slip finish: Fused aluminum oxide grits, graded 12/30. Use factory-graded rustproof and non-glazing material that is unaffected by freezing, moisture and cleaning materials.
   1. Products offered by manufacturers to comply with the above requirements include: A-H Alox; Anti-Hydro Waterproofing Co., Toxgrip; Toch Div. - Carboline, or approved equal.

H. Expansion Joint Filler:
   1. Joint fill shall be a preformed non-extruded resilient filler, saturated with bituminous materials and conforming to ASTM D 1751. Products shall be equivalent to Burke "Fiber Expansion Joint", W.R. Meadows "Fibrated Expansion Joint Filler", or approved equal.

I. Bonding Agent: Sonneborn "Sonobond"; the Euclid Chemical Company "Euco-Weld"; Larsen Products Corp., "Weld-Crete" or approved equivalent.

J. Concrete Sealer: Cure and Seal, as manufactured by the Euclid Chemical Company "Aqua-Cure VOX", Sonneborn "Kure-N-Seal WB", Burke "Spartan-Cote",W.R. Meadows "Intex" or approved equal conforming to ASTM C-309, Type I, Class B requirements, and conforming to State of California Air Resources Board VOC Regulations.

K. Concrete Hardener/Sealer: Clear, water soluble, sprayable in-organic silicate based hardener/sealer or acrylic co-polymer resin. Products shall be equal to Euclid Chemical Company "Eucosil", Burke "Spartan-Cote", Sonneborn "Sonosil", W.R. Meadows "Pena-Lith", or approved equal and must conform to State of California Air Resources Board VOC Regulations.

L. Concrete Cure: Water based curing compound conforming to ASTM C-309, Type 1, Class A and B, and AASHTO Specification M-148; Type 1, Class A and B requirements, and State of California Air Resources Board VOC Regulations. Product shall be equivalent to Euclid Chemical Company "Kurez VOX", Burke "No. 1127" or "Aqua-Resin Cure", W.R. Meadows "1100 Clear", or approved equal.

M. M. Non-Shrink Grout: See Section 2.2.A.7

2.2 CONCRETE

A. Concrete Mixes:

1. Type A Concrete:
   Strength: 3000 lbs. per square inch at 28 days.
   Maximum aggregate size: 1-1/2 inch.
   Cement content: as required by mix design (ACI 318 section 5.2).
   Sacks per yard minimum.
   Maximum water to cement ratio: 0.58
   Admixture: water reducing.
   Weight: 145 lbs. per cubic foot
   Use for unexposed foundation concrete except as otherwise specified. at contractor's option,
   Type B concrete may be substituted for this.
2. Type B Concrete:
   Strength: 3500 lbs. per square inch at 28 days.
   Maximum aggregate size: 1 inch.
   Minimum cement content: as required by mix design. (ACI 318 section 5.2).
   Sacks per yard minimum.
   Maximum water to cement ratio: 0.45
   Admixture: water reducing.
   Weight: 145 lbs. per cubic foot
   Use for building slab on grade
   Maximum fly ash content as a percentage of total cementitious material: 15%
3. Type C Concrete:
   Strength: 2500 lbs. per square inch at 28 days.
   Maximum aggregate size: 1 inch.
   Minimum cement content: as required by mix design (ACI 318 section 5.2).
   Sacks per cubic yard.
   Maximum water to cement ratio: 0.60
   Admixture: water reducing.
   Weight: 145 lbs. per cubic foot.
   Use for concrete sidewalks, mechanical and electrical pads, miscellaneous non-structural slabs on grade.

4. Grout shall be non-shrink, non-metallic, flowable Type "713" or "928" by Master Builders.
   a. Metallic grout equivalent to Master Builders "Embeco" may be used only where covered by earth, concrete, or masonry.
   b. Acceptance by Architect required before using.

B. Consistency of Concrete: Concrete slump, measured in accordance with ASTM C 143, shall fall within following limits.

1. For General concrete placement: 3 inch plus or minus 1 inch.
2. Mixes employing the specified mid-range water reducer shall provide a measured slump not to exceed 7 inch $\pm$1 inch after dosing, 2 inch $\pm$1 inch before dosing.
3. Concrete slump shall be taken at point of placement. Use water reducing admixtures as required to provide a workable consistency for pump mixers. Water shall not be added at the jobsite without written review by the structural engineer.

C. Mix Design:

1. Initial mix design shall be prepared for all concrete in accordance with ACI 318 section 5.2. Mix proportions shall be determined in accordance with ACI 318 Section 5.3 or ACI 318 section 5.4. In the event that additional mix designs are required due to depletion of aggregate sources, aggregate not conforming to Specifications, or at request of Contractor, these mixes shall be prepared as above.
2. Contractor shall notify the Testing Laboratory and Architect of intent to use concrete pumps to place concrete so that mix designs can be modified accordingly.
3. Fly ash shall not exceed fifteen percent of the total cementitious material.
4. Provide 3% air entrainment typical, 6% for mixes exposed to freeze-thaw cycles.
5. Owner's testing laboratory shall review all mix design before submittal.

D. Mixing:
1. Equipment: All concrete shall be machine mixed. Provide adequate equipment and facilities for accurate measurement and control of materials.
2. Method of Mixing:
   a. Transit Mixing: Comply with ASTM C 94. Ready mixed concrete shall be used throughout, except as specified below.
   b. On-Site Mixing: Use only if method of storing material, mixing of material and type of mixing equipment is approved by Architect. Approval of site mixing does not relieve Contractor of any other requirements of Specifications.
   c. Mixing shall be in accordance with ACI 318 5.8.
3. Mixing Time: After mix water has been added, concrete shall be mixed not less than 1-1/2 minutes nor more than 1-1/2 hours. Concrete shall be rejected if not deposited within the time specified.
4. Admixtures:
   a. Air entraining and chemical admixtures shall be charged into mixer as a solution and shall be dispensed by an automatic dispenser or similar metering device. Powdered admixtures shall be weighed or measured by volume as recommended by manufacturer. Accuracy of measurement of any admixture shall be within plus or minus 3%.
   b. Two or more admixtures may be used in same concrete, provided such admixtures are added separately during batching sequence, and provided further that admixtures used in that combination retain full efficiency and have no deleterious effect on concrete or on properties of each other.
   c. All admixtures are to be approved by Structural Engineer prior to commencing this work.
5. Retempering:
   a. Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall be discarded, not retempered.
   b. Indiscriminate addition of water to increase slump is prohibited.
   c. When concrete arrives at project with slump below that suitable for placing, water may be added only if neither maximum permissible water-cement ratio nor maximum slump is exceeded. Water shall be incorporated by additional mixing equal to at least half of total mixing time required. Any addition of water above that permitted by limitation of water-cement ratio shall be accompanied by a quantity of cement sufficient to maintain proper water-cement ratio. Such additions shall only be used if approved by Architect. In any event, with or without addition of cement, not more than 2 gallons of water per cubic yard of concrete, over that specified in design mix, shall be added.
6. Cold Weather Batching: When temperature is below 40 degrees F or is likely to fall below 40 degrees F during 24 hour period after placing, provide adequate equipment for heating concrete materials. No frozen materials or materials containing ice shall be

used. Temperatures of separate materials, including mixing water, when placed in mixer shall not exceed 100 degrees F. When placed in forms concrete shall have a temperature between 50 degrees F and 85 degrees F.

7. Hot Weather Batching: Concrete deposited in hot weather shall have a placing temperature below 85 degrees F. If necessary, ingredients shall be cooled to accomplish this.

2.3 FLOOR LEVELING AND FILL MATERIALS

A. Epoxy Concrete Mortar: Floor leveling, non-shrink trowel applied epoxy concrete mortar; TPM 115 General Polymers Corp., A-H Emery Epoxy Topping #170 Anti-Hydro Corp., or approved equal, where areas to fill are less than 1/4 inch thick.

B. Concrete Mortar: Floor leveling, patching and repair, non-shrink trowel applied concrete mortar; Master Builders EMBECO 411-A, Euclid EUCO, or approved equal, where areas of fill are greater than 1/4 inch thick.

C. Cementitious Floor Leveling Material: Shall be self-leveling or trowelable with a minimum 28 day compressive strength of 3000 psi in accordance with ASTM C-109. Material shall be equal to Quickrete No. 1249, Ardex V-800/K-55, Mapei "Ultra/Flex" or approved equal.

2.4 ANTI-GRAFFITI COATING

A. Exterior two-coat application, for Graffiti Removal and Control; Sherwin-Williams Pro Industrial Anti-Graffiti Coating, non-sacrificial coating, or approved equal.

PART 3 - EXECUTION

3.1 PLACEMENT

A. Before any concrete is placed, the following items of work shall have been completed in the area of placing.
1. Forms shall have been erected, adequately braced, cleaned, sealed, lubricated if required, and bulkheaded where placing is to stop.
2. Any wood forms other than plywood shall be thoroughly water soaked before placing any concrete. The wetting of forms shall be started at least 12 hours before concreting.
3. Reinforcing steel shall have been placed, tied and supported.
4. Embedded work of all trades shall be in place in the forms and adequately tied and braced.
5. The entire place of deposit shall have been cleaned of wood chips, sawdust, dirt, debris, hardened concrete and other foreign matter. No wooden ties or blocking shall be left in the concrete except where indicated for attachment of other work.
6. Reinforcing steel, at the time the concrete is placed around it, shall be cleaned of scale, mill scale or other contaminants that will destroy or reduce bond.
7. Concrete surfaces to which fresh concrete is to be bonded shall be brush cleaned to remove all dust and foreign matter and to expose the aggregate, and then coated with the bonding adhesive herein specified.
8. Prior to placing concrete for any slabs on grade, the moisture content of the subgrade below the slabs shall be adjusted to at least optimum moisture.
9. No concrete shall be placed until formwork and reinforcement has been approved by Architect. Clean forms of all debris and remove standing water. Thoroughly clean reinforcement and all handling equipment for mixing and transporting concrete.

Concrete shall not be placed against reinforcing steel that is hot to the touch. Notify Architect 48 hours in advance of concrete pour.

B. Conveying: Handle concrete from mixer to place of final deposit by methods which will prevent separation or loss of ingredients. Deposit concrete in forms as nearly as practicable at its final position in a manner which will insure that required quality is obtained. Chutes shall slope not less than 4 inches and not more than 6 inches per foot of horizontal run.

C. Depositing: Deposit concrete into forms in horizontal layers not exceeding 24 inches in thickness around building, proceeding along forms at a uniform rate and consolidating into previous pour. In no case shall concrete be poured into an accumulation of water ahead of pour, nor shall concrete be flowed along forms to its final place of deposit. Fresh concrete shall not be permitted to fall from a height greater than 6 feet without use of adjustable length pipes or, in narrow walls, of adjustable flexible hose sleeves. Concrete shall be scheduled so that placing is a continuous operation for the completion of each section between predetermined construction joints. If any concreting operation, once planned, cannot be carried on in a continuous operation, concreting shall stop at temporary bulkheads, located where resulting construction joints will least impair the strength of the structure. Location of construction joints shall be as shown on the drawings or as approved by Structural Engineer. The rate of rise in walls shall not be less than 2 feet per hour.
   1. Consolidation: Concrete shall be thoroughly compacted and worked to all points with solid continuous contact to forms and reinforcement to eliminate air pockets and honeycombing. Power vibrators of approved type shall be used immediately following pour. Spading by hand, hammering of forms or other combination of methods will be allowed only where permitted by Structural Engineer. In no case shall vibrators be placed against reinforcing steel or used for extensive shifting of deposited fresh concrete. Provide and maintain standby vibrators, ready for immediate use.
   2. Hot Weather Concreting: Unless otherwise directed by the Architect, perform all work in accordance with ACI 305 when air temperature rises above 75 degrees F and the following:
      a. Mixing Water: Keep water temperature as low as necessary to provide for the required concrete temperature at time of placing. Ice may be required to provide for the design temperature.
      b. Aggregate: Keep aggregate piles continuously moist by sprinkling with water.
      c. Temperature of Concrete: The temperature of the concrete mix at the time it is being placed in the forms shall not exceed 85 degrees F. The method employed to provide this temperature shall in no way alter or endanger the design mix or the design strength required. Dampen subgrade and formwork before placing concrete. Remove all excess water before placing concrete. Keep concrete continuously wet when air temperature exceeds 85 degrees F for a minimum of 48 hours after placing concrete. For slab on grade construction, see Section 3.1.E.
      d. Protection: Minimize evaporation from concrete in place by providing shade and windbreaks. Maintain such protection in place for 14 days minimum.
   3. Cold Weather Concreting: Follow recommended ACI 306 procedures when air temperature falls below 40 degrees F., as approved by Architect. Concrete placed in freezing temperatures shall have a temperature of not less than 50 degrees F. Maintain this temperature for at least 7 days. No chemicals or salts shall be used to prevent freezing and no accelerating agents shall be used without prior approval from Architect.

D. Construction Joints: Install only as indicated and noted on Drawings. Joints not indicated on Drawings shall be so located, when approved, as to least impair strength of structure, and

shall conform to typical details. Construction joints shall have level tops, vertical sides. Horizontal construction joints shall be thoroughly cleaned and roughened by removing entire surface film and exposing clean aggregate solidly embedded in mortar matrix. Joints between concrete and masonry shall be considered construction joints. Vertical construction joints need not be roughened. See Drawings for doweling and required keys.

1. Roughen construction joints by any of following methods:
    a. By sandblasting joint.
    b. By thoroughly washing joint, using a high pressure hose, after concrete has taken initial set. Washing shall be done not less than 2 hours nor more than 4 hours after concrete has been poured, depending upon setting time.
    c. By chipping and wire brushing.
2. All decisions pertaining to adequacy of construction joint surfaces and to compliance with requirements pertaining to construction joints shall be reviewed with the Structural Engineer.
3. Just before starting new pour, horizontal and vertical joint surfaces shall be dampened (but not saturated).
4. Before placing regular concrete mix, horizontal construction joint surfaces shall be covered with a layer of mortar composed of cement and fine aggregate of same proportions as that used in prescribed mix, but omitting coarse aggregate.
5. For slabs, construction joints shall be in locations shown on plan. If not shown, locate at intervals not exceeding 150 feet in each direction. Refer to drawings for proper details for reinforcing at construction joints.

E. Concrete Slabs on Grade:
1. Exterior and interior concrete slabs on grade shall be poured as required under this Section. Base shall be accurately leveled and compacted prior to placing of concrete.
2. Typically, interior slabs on grade shall be poured over a minimum of four (4 inch) inches of compacted crushed rock, unless otherwise indicated, over a vapor retarder.
3. Protect slab on grade subbase from moisture prior to placing concrete. Avoid wetting rock layer to allow adequate concrete curing and avoid future vapor transmission. If the subbase has been wet excessively, verify that water has been eliminated prior to placement of concrete.
4. Vapor Retarder installation shall be in accordance with manufacturer’s instructions and ASTM E 1643-98.
    a. Unroll Vapor Retarder with the longest dimension parallel with the direction of the pour.
    b. Lap Vapor Retarder over footings and seal to foundation walls.
    c. Overlap joints 6 inches and seal with specified tape.
    d. Seal all penetrations (including pipes) per manufacturer’s instructions.
    e. No penetration of the Vapor Retarder is allowed except for reinforcing steel and permanent utilities.
    f. Repair damaged areas by cutting patches of Vapor Retarder, overlapping damaged area 6 inches and taping all four sides with tape.

F. Control Jointing - Slabs on Grade:
1. Joints shall be in locations indicated on Drawings, or as directed by Architect.
2. Joints in interior slabs shall be made by one of following methods:
    a. By use of construction joints laid out in checkerboard pattern; pour and allow alternate slabs to set; fill out balance of checkerboard pattern with second pour.
    b. By use of dummy groove joints at least 1/4 depth of slab, and at least 1/8 inch wide. These joints may be sawcut as soon as wet concrete can support the

weight of the equipment and operator. Delaying sawcutting past this point will make jointing ineffective.

3. Control jointing in exterior paving slabs shall be laid out in a checkerboard pattern; pour as described above, but with joint edges tooled to provide a uniform joint at least 3/8 inch in depth.
4. Slab reinforcing need not be terminated at control joints.
5. Construction and expansion joints shall be counted as control joints.

G. Expansion Joints:
1. Unless otherwise indicated, use 3/8 inch thick expansion joint filler. See Section 2.1 H
2. Joints in interior slabs on grade shall be only in locations indicated.
3. Joints in exterior slabs on grade shall be installed at each side of structures, at curb transitions opposite apron joints, at ends of curb returns, at back of curb when adjacent to sidewalk, and at uniformly spaced intervals not exceeding 20 feet.
4. Edges of concrete at joints shall be edger finished to approximately 3/8 inch radius.
5. Interrupt reinforcing at all expansion joints.

H. Score markings on exterior slabs on grade shall be located as indicated. Where not indicated, mark slabs into rectangles of not less than 12 square feet nor more than 20 square feet using a scoring tool which will leave edges of score markings rounded.

3.2 CURING AND PROTECTION

A. Curing: Exposed surfaces of all concrete used in structure shall be maintained in a moist condition for at least 7 days after placing. The following final curing processes shall normally be considered to accomplish this. Concrete shall be maintained at not less than 50 degrees F nor more than 100 degrees F for a period of 72 hours after being deposited.
1. Flatwork to be exposed, stained, or painted shall have curing process submitted and approved by the architect prior to construction.
2. Initial Curing Process - Flat Work:
a. Mist Spraying: As soon as troweling of concrete surfaces is completed, exposed concrete shall be sprayed continuously with a special atomizer spray nozzle, capable of producing a fine mist. Spraying shall be done without any dripping of water from nozzle. Amount of spraying shall be such as to maintain surface of concrete moist without any water accumulating on surface. Maintain spraying for a minimum of 12 hours, or until such time as hereinafter described curing process is applied. Mist spraying will not normally be required when the ambient air temperature is below 90 degrees F.
3. Final Curing Process - Flatwork: Except as noted, use any of following:
a. Water Curing: Concrete shall be kept wet by mechanical sprinklers or by any other approved method which will keep surfaces continuously wet.
b. Saturated Burlap Curing: Finished surfaces shall be covered with a minimum of two layers of heavy burlap which shall be kept saturated during the curing period.
c. Curing Compounds: Membrane curing compounds of chlorinated rubber or resin type conforming to ASTM C309 may be used only if specifically approved by Architect. Use of membrane curing compound will not be permitted on surfaces to be painted, or to receive ceramic tile, membrane water-proofing or hardeners and sealers. Membrane curing compound may be used in areas to receive resilient floor tile, provided it is wax-free, compatible with adhesive used and approved by adhesive manufacturer. Agitate curing compounds thoroughly by mechanical means continuously during use and spray or brush uniformly in accordance with manufacturer's recommendations. Apply immediately following

final finishing operation. All curing compounds shall conform to State of California Air Resources Board VOC Regulations.

d. Waterproof paper conforming to ASTM C 171, or opaque polyethylene film, may be used. Concrete shall be covered immediately following final finishing operation. Anchor paper or film securely and seal all edges in such a manner as to prevent moisture escaping from concrete.

4. Curing Process - Formed Surfaces: Forms heated by sun shall be kept moist during curing period. If forms are to be removed during curing period, curing as described for flatwork shall be commenced immediately.

B. Refer to Drawings for areas of concrete slab not to receive curing compounds or hardening compounds. Where concrete floors are to receive heavy duty coatings, waterproof coatings and the like, verify with coating installer the type of finish required for specified coating.

C. Protection: Contractor shall be responsible for protection of finished concrete against injury by rain, cold, vibration, animal tracks, marking by visitors, vandalism, etc.

D. Provide additional curing agents or compounds, not necessarily listed herein, but as recommended and or required for use with shake type hardeners or other special coatings and coverings by their manufacturers for a complete and proper installation.

3.3 FINISHES

A. Formed Surfaces:
1. Rough Form Finish: Surfaces shall be reasonably true to line and plane with no specified requirements for selected facing materials. Tie holes and defects shall be patched and fins exceeding 1/4 inch in height shall be rubbed down with wooden blocks. Fins and other rough spots at surfaces to receive membrane waterproofing shall be completely removed and the surfaces rubbed smooth. Otherwise, surfaces shall be left with the texture imparted by forms.
a. Rough finish shall be used for the following areas:
1) Below grade and unexposed surfaces.
2. Smooth Plywood Form Finish: Finish shall be true to line and plane. Tie holes and defects shall have been patched and ground with surface fins removed. Arrangement of plywood sheets shall be orderly, symmetrical, as large as practical and free of torn grain or worn edges. Surface concrete shall be treated with 1 part muriatic acid, in three parts water solution, followed immediately by a thorough rinsing with clear water. Surfaces which are glazed, have efflorescence, or traces of form oil, curing compounds or parting compounds shall be cleaned or treated to match other formed surfaces, except as otherwise indicated or specified.
a. Smooth Plywood Form Finish shall be used for the following areas:
1) All surfaces above grade unless otherwise specified.
2) At Contractor's option, may also be used in lieu of rough form finish.
3. Smooth Plastic Liner Finish: Surface shall be smooth, concrete free of honeycombing, air pockets larger than 1/8 inch in diameter, and fins.
a. This finish shall be used at all exposed exterior concrete stem walls.

B. Flatwork:
1. Unless otherwise indicated or specified, flatwork shall have an integral monolithic finish.
2. Integral Monolithic Finish: Apply as soon as freshly poured concrete slabs will bear weight of workers. Pour slabs full thickness to finish floor elevations indicated. At proper time, tamp surface repeatedly with a wire mesh or grid tamper in a manner to force

aggregate down below surface and to bring sufficient mortar to surface to provide for a smooth coating of cement mortar over entire surface. Allow surface mortar to partially set, then float with wooden floats and finish with one of following, as required.

a. Broom Finish: Steel trowel surface to a smooth dense surface free of lines, tool marks, cat faces and other imperfections. After troweling, and before final set, give surface a broom finish, brushing in direction noted on Drawings, or as directed. Broom finish shall be used typically on exterior flatwork except as otherwise indicated or specified and shall be "medium" texture as approved by Architect. Vehicular concrete shall have a “heavy” broom finish.
b. Smooth Steel Trowel Finish: Apply 2 steel trowelings to obtain hard, smooth surface. All lips, irregularities, uneven levels, etc. shall be worked out before last troweling. All interior flatwork shall have a smooth steel trowel finish unless specified otherwise.

3. Tolerances:
   a. For tolerances not indicated, refer to ACI 117.
   b. Slabs on grade – Comply with F_F & F_L as specified by Architect, or at a minimum shall be sufficiently even to contact a 10' long straightedge with a tolerance of 1/8 inch.
   c. Concrete over metal deck – Refer to Section 05 30 00 for minimum requirements.
   d. Elevated slabs – Comply with Architectural requirements.
   e. Finished surfaces of exterior integral finished flatwork shall not vary more than 1/4 inch from a 10' long straightedge, except at grade changes.

C. Sacked Surfaces: Exposed surfaces that are unacceptable in appearance to the Architect shall be sacked.
   1. Prepare concrete surfaces in accordance with the referenced standards. Remove any form release materials by stoning by hand, power grinding or other method approved by the Architect.
   2. Prepare concrete surfaces to receive sack finishing with a light sand blasting.
   3. For best results, grout application and rubbing should be performed when areas to be treated are shaded and during cool, damp weather. When work is to be performed in hot and dry weather, a fog spray should be available for continuous use.
   4. Prepare grout samples for matching of concrete surfaces for approval by the Architect. These shall be made in the following proportions of gray cement to white cement to sand: 1:1:2, 1:2:3, and 2:1:3, etc. until the correct matching color is obtained on the test areas. Sand should be fine enough to pass the Number 30 sieve. Mixes should be made to a good workable consistency in a clean container and the mix with the best color chosen, or modified if needed.
   5. Provide sufficient qualities of sand and cement from the same source for the complete work at the job site.
   6. Mixing and Application:
      a. Mixing of grout on the job should be timed for it to be used up within 1 to 1-1/2 hours.
      b. Let the grout stand 20 to 30 minutes after mixing, and then remixed before applying.

c. Soak the concrete surface thoroughly with water at least 15 minutes before applying grout and again just before application so that the surface is adequately wet during the operation.
d. Apply grout with plasterer's trowel or sponge rubber float in sweeping strokes from the bottom up. Brush or spray gun applications may be used when approved by the Architect.
e. Work in freshly applied grout vigorously with a sponge rubber float, then let sit until some of its plasticity is gone but not until it loses its damp appearance. At this point it shall be rubbed with clean, dry burlap to remove the excess grout, leaving no visible film on the surface but filling all air holes.
f. Keep the surface wet for a day after grouting and sack rubbing are completed.
g. Alternate methods of application and materials shall be subject to the approval of the Architect.

3.4 PATCHING

A. Formed Surfaces:
1. Promptly upon removal of contact forms and after concrete surfaces have been inspected, form ties shall be removed and all necessary patching and pointing shall be expertly done.
2. Honeycombed areas shall be removed down to sound concrete, coated with a bonding grout or approved compound and patched using a low shrinkage high bond mortar. Patched areas shall be cured by being kept damp for at least 5 days.
3. Tie holes shall be cleaned, dampened and filled solid with patching mortar or cement plugs of an approved variety.

B. Slabs on Grade: After entire slab is finished, shrinkage cracks that may appear shall be patched as follows:
1. Where slab is not exposed or where appearance is not important, cracks larger than 1/32 inch wide shall be filled with cement grout and struck off level with surface.
2. Where slab is exposed and appearance is important, unsightly cracks shall be repaired in a manner satisfactory in appearance to Architect. If this cannot be accomplished, concrete shall be considered defective.

3.5 DEFECTIVE CONCRETE

A. Defective concrete shall mean any of the following:
1. Concrete not meeting 100 percent of the specified 28 day compressive strength.
2. Concrete exhibiting rock pockets, voids, spalls, streaks, cracks, exposed reinforcing to extent that strength, durability, or appearance is adversely affected.
3. Concrete significantly out of place, line, or level.
4. Concrete not containing the required embedded items.

B. Upon determination that concrete strength is defective:
1. Should cylinder tests fall below minimum strength specified, concrete mix for remainder of work shall be adjusted to produce required strength. Core samples shall be taken and tested from cast-in-place concrete where cylinders and samples indicate inferior concrete with less than minimum specified strength.
a. Cores of hardened concrete shall be taken and tested in accordance with ASTM C 42 and C 39. Number and location of such cores shall be subject to the approval of Architect.
b. Cost of core sampling and testing will be paid for by the Contractor.
c. “85 percent” reduction in ACI 318 5.6.5.4 will not justify low cylinder tests.

C. Upon determining that concrete surface is defective, Contractor may restore concrete to acceptable condition by cutting, chipping, pointing, patching, grinding, if this can be done without significantly altering strength of structure. Permission to patch defective areas will not be considered a waiver of the right to require removal if patching does not, in the opinion of the Architect, satisfactorily restore quality and appearance.

D. If core tests indicate that concrete is below the strength specified, or if patching does not restore concrete to specified quality and appearance, the concrete shall be deemed defective, and shall be removed and replaced without additional cost to the Owner.

E. No repair work shall begin until procedure has been reviewed by the Architect and Structural Engineer.

3.6 SURFACE HARDENER AND SEALER

A. A. Seal all interior exposed flatwork with clear sealer, except surfaces receiving ceramic tile, quarry tile, poured flooring or other special finishes specified, or as scheduled on the Drawings.
   1. Apply sealer in 2 or 3 coats, in accordance with manufacturer's directions, using the maximum quantity recommended.
      a. Concrete floors must be thoroughly cured for a minimum of 30 days and completely dry before treatment.
      b. Surfaces to be treated must be clean, free of membrane curing compounds, dust, oil, grease and other foreign matter.
      c. Upon completion, concrete surfaces shall be clean and without discoloration or traces of excess hardener left on the surface.

B. Apply sprayable hardener/sealer at locations as scheduled or as indicated on the Drawings. Apply in accordance with the manufacturer's favorably reviewed application instructions and recommendations.

3.7 GROUTING

A. Prepare and place grout materials at locations as indicated on the Drawings in accordance with the manufacturer's recommendations and installation instructions.

B. Pack grout materials solidly between bearing surfaces and bases or plates as indicated and to ensure no voids.

3.8 ANTI-GRAFFITI COATING

A. Anti-Graffiti Coating shall be done after installation of joint sealant specified in Section 07920.

B. Surface preparation: Masonry must be clean, dry and free of excess dust and mortar. New masonry surfaces must be allowed to cure for 10 days prior to application under normal weather conditions. After a rain, allow at least three days for masonry to dry thoroughly; do not apply if rainfall is anticipated within 24 hour cure cycle. Mask adjacent areas to protect from overspray.

C. Application: Follow manufacturer's written direction for additional details.

D. Coverage: Apply at average rate not to exceed manufacturer's written direction. Apply full-height of exposed exterior concrete stem walls.

3.8 ADJUSTING AND CLEANING

A. Remove all debris, excess materials, tools and equipment resulting from or used in this operation at completion of this work.

END OF SECTION

SECTION 03 54 15

PORTLAND CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Liquid-applied, high-strength, fast-setting, non-shrink cement underlayment where needed for patching, filling, and leveling floors to meet requirements of applied floor finish.

B. Related Requirements:
1. Concrete Moisture Testing: Section 01 4520.
2. Cast-in-Place Concrete: Section 03 3000.
3. Finishes: Division 09; applied floor coverings.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures: Action and Informational Submittals shall be submitted in accordance with Section 01 33 00, “Submittal Procedures.”

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's literature describing materials and specifications for mixing, placing, curing, and protecting.

1.4 INFORMATIONAL SUBMITTALS

A. Statement of applicator qualifications for self-leveling underlayment, if used.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications for Self-Leveling Underlayment: Approved, in writing, by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ensure that storage facilities are weathertight and dry.

B. Comply with additional requirements specified in Section 01 60 00, "Product Requirements."

1.7 FIELD CONDITIONS

A. Ambient Conditions:
1. Spaces to receive underlayment shall be maintained at a temperature above 40 degrees F before and during installation.
2. During the curing process, ventilate spaces to remove excess moisture.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Sustainable Design:
1. Provide Portland Cement materials with the highest available levels of post-consumer and pre-consumer recycled content, calculated as the sum of postconsumer recycled content plus one-half of the preconsumer content.
2. When available, provide products, including raw materials, which have been extracted, harvested, recovered and manufactured within 500 miles of the project site.
3. Products applied inside of the waterproofing barrier of the building shall have VOC content equal to or less than the applicable VOC limits.

2.2 MANUFACTURERS

A. Portland Cement Underlayment: Ardex Inc. as specified, Raeco by Silpro LLC Inc., Thoro System products, or equal.

2.3 MATERIALS

A. General: Materials listed below are not necessarily all-inclusive, nor are all materials listed necessarily required to be used.

B. Self-Leveling Underlayment: Non-structural, premixed blend of cement, graded aggregate, polymers, and control additives capable of being installed to feather edge; “Ardex K 10” in pre-blended bags, or accepted equal.
1. Cure Time:
a. Moisture-Insensitive Tile: 6 hours.
b. Other Floor Coverings: 16 hours; verify with manufacturer.
2. Compressive Strength: 4,700 psi at 28 days, ASTM C109/mod – air cure only.

C. Floor Patching Filler: “Ardex Feather Finish” or accepted equal, for non-moving cracks and joints.

D. Primer:
1. Absorbent Concrete: “Ardex P 51 Primer” unless otherwise recommended by manufacturer for existing conditions.
2. Non-Porous Substrates: “Ardex P 82 Ultra Prime” unless otherwise recommended by manufacturer for existing conditions.

E. Water: Clean and potable, free from impurities detrimental to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate, and verify that surfaces are free from debris, oil, grease, wax, curing compounds, and dust and are reasonably clean and dry and that conditions are otherwise suitable to receive underlayment.

3.2 PLACING OVER CONCRETE

A. General:
1. Follow manufacturer's technical bulletins for application of each product.
2. Do not exceed thickness recommended by manufacturer for mix without aggregate or supplemental reinforcing.
3. Select proper primer for condition of substrate, mix, and apply with rubber squeegee over entire surface to receive underlayment.
4. Pour or pump concrete compound, as applicable to selected product, in accordance with manufacturer's printed instructions.

B. Use self-leveling underlayment where necessary to bring large areas of existing concrete substrate into levelness and flatness tolerances required for application of applied floor coverings. Install in one pour from feather edge spreading and screeding to a smooth surface.

C. Finish shall be as recommended by manufacturer for reception of specified finish materials.

3.3 CURING

A. Allow underlayment to harden as recommended by manufacturer.

B. Do not allow traffic on underlayment during hardening period; minimum 2 hours or longer if special conditions exist.
1. Do not load floors until reasonable strength has been achieved.
2. Any loading on topping shall be distributed and not concentrated.

C. Maintain adequate ventilation and temperature above 50 degrees F until underlayment is dry.

3.4 ADJUSTMENT

A. Underlayment is subject to testing specified in Section 01 4520," Concrete Moisture Testing," prior to application of finish flooring materials.

B. Repair defects, evident after curing, that make underlayment an unacceptable substrate for finish flooring. Use materials recommended by underlayment manufacturer.
1. Fill dimples.
2. Sand down protrusions smooth and flush with adjacent surface.
3. Leveling at sills.

C. Repair underlayment damaged after installation prior to installation of scheduled floor finish.

END OF SECTION

SECTION 04 05 00

MORTAR AND GROUT

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of Division 1 apply to all Work of this Section.

1.2 SCOPE

A. A. Provide all materials, labor and accessories as required and specified for complete mortar and grout installation in masonry walls.

1.3 RELATED WORK (SEE ALSO TABLE OF CONTENTS):

A. Cast-In-Place Concrete: Section 03 30 00.

B. Concrete Unit Masonry: Section 04 22 00.

C. Reinforcing Steel: Section 03 20 00.

1.4 QUALITY ASSURANCE

A. Standards and References: (Latest Edition unless otherwise noted)
1. ASTM C144, Aggregate for Masonry Mortar.
2. ASTM C150, Portland Cement.
3. ASTM C207, Hydrated Lime for Masonry Purposes
4. ASTM C270, Standard Specification for Mortar for Unit Masonry
5. ASTM C404, Aggregates for Grout
6. ASTM C476, Standard Specification for Grout for Masonry
7. ASTM C1019, Method of Sampling and Testing Grout
8. CBC Section 2103
9. 2022 California Building (CBC)
10. Masonry Standards Joint Committee (MSJC)

B. Tests and Inspections:
1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the 2022 CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
2. All tests and inspections herein are to be performed by an independent testing laboratory approved by the building official.
3. Mortar and Grout Tests: If mortar and grout tests are indicated as required on the Structural drawings, at the beginning of Masonry Work, at least 1 test sample each of mortar and grout shall be taken on 3 successive working days, then once per week with at least one sample taken for each 5000 square feet of wall area, or fraction thereof.
   a. Test specimens shall be made in accordance with ASTM C1019 for grout and ASTM C780 for mortar.
   b. Test specimens shall be continuously stored in moist air until tested.

c. Mortar shall show a compressive strength of not less than 1800 psi at 28 days. Grout shall show a compressive strength of not less than 2000 psi at 28 days.

4. If masonry placement and grouting inspection is indicated as required on the Structural Drawings, a special inspector shall be employed per CBC Section 1704 during the placement of all units, placement of all reinforcing steel, during all grouting operations and during taking of all test specimens.

C. Submittals:
1. Mix design for mortar and grout shall be submitted for review.
2. Supplier's certificates indicating materials comply with the specifications below. They shall include but are not necessarily limited to:
a. Aggregates
b. Cement
c. Admixtures

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PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement: ASTM C 150, Type I or II, low alkali; natural gray.

B. Hydrated Lime: ASTM C 207, Type S.

C. Quicklime: ASTM C 5.

D. Lime Putty: Made from hydrated lime or quicklime.
1. If made from quicklime, other than processed pulverized quicklime, slake lime and then screen through a No. 16 mesh sieve. Before using, store and protect slaked and screened lime putty for not less than 10 days.
2. Processed pulverized quicklime shall be slaked for not less than 48 hours, and shall be cool when used.
3. Lime putty prepared from hydrated lime may be used immediately after mixing.
4. Lime putty prepared from quicklime or pulverized quicklime shall have a plasticity figure, after slaking and screening, of not less than 200, and shall weigh not less than 83 lbs. per cubic foot. Lime putty prepared from hydrated lime shall conform to ASTM C 207, Type S.

E. Aggregate:
1. For Mortar: ASTM C144.
2. For Grout: ASTM C404.

F. Admixture: "Sika Grout Aid"

G. Water: Suitable for domestic consumption.

2.2 MORTAR

A. Mortar shall be Type S having a 28 day compressive strength of not less than 1800 psi, and shall conform to CBC Section 2103.

B. Mortar shall be made with admixtures that are proportioned, added and mixed in strict accordance with manufacturer's directions.

C. Mortar mix shall be proportioned by volume; one part portland cement, not less than 1/4 part nor more than ½ part lime putty, and sand totaling not less than 2-1/4 nor more than 3 times sum of volumes of cement and lime used.
   1. Total clay content shall not exceed 2% of sand content or 6% of cement content.

2.3 GROUT

A. Grout shall have a 28-day compressive strength of not less than 2000 psi. Proportion by volume, and with sufficient water to produce consistency for pouring without segregation so that grout will flow into masonry joints. Grout shall conform to CBC Section 2103.

B. Fine Grout: 1 part portland cement, to which may be added not more than 1/10 part lime putty, and 3 parts sand.
   1. Fine grout shall be used for all grout spaces less than 3" wide.

C. Coarse Grout: 1 part portland cement, to which may be added not more than 1/10 part lime putty, 3 parts sand and not less than 1 part nor more than 2 parts pea gravel (3/8” maximum aggregate size).
   1. Coarse grout shall be used in grout spaces 3" wide or more.

D. Add “Sika Grout Aid” admixture to grout at the rate of 1 pound per 100 pounds cementitous material.

PART 3 - EXECUTION

3.1 MIXING MORTAR AND GROUT

A. Accurately measure materials in suitably calibrated devices; shovel measurements are not acceptable. Each 94lb. sack of portland cement will be considered as 1 cubic foot.

B. Place sand, cement and water in mixer in that order and mix for at least 2 minutes; then add lime putty and continue mixing as long as necessary to secure a uniform mass, but in no case less than 10 minutes.

C. Use mixers of at least 1 sack capacity; batches requiring fractional sacks will not be permitted unless cement is weighed for each batch.

3.2 GROUTING PROCEDURES

A. Specified under Sections 04 22 00 and 04 21 00.

3.3 RETEMPERING

A. When necessary to retemper mortar, add water and remix; retempering by dashing water over mortar will not be permitted.

B. Any mortar which is unused within 30 minutes after initial mixing and any mortar that has begun to set shall not be used.

3.4 DEFECTIVE MORTAR OR GROUT

A. Should the strength of mortar or grout fall below that specified, remainder of Work shall be adjusted to reach required strength. Work in place representing inferior grout and mortar and

indicating a strength less than the minimum specified shall be tested by taking and testing core samples. Number and location of cores shall be determined by Structural Engineer.

B. Should compression tests of cores fail to meet required strength, masonry shall be deemed to be defective and shall be removed and replaced at no cost to Owner.

C. Costs relative to taking and testing of core samples shall be paid by Owner and will be deducted from Contract Amount. Cost of patching core holes shall be borne by Contractor.

END OF SECTION

SECTION 04 22 00

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of Division 1 apply to all Work of this Section.

1.2 SCOPE

A. Furnish and install all concrete unit masonry, reinforcement, and all required accessories and materials as shown on the Drawings and specified here.
   1. Cooperate with other trades for embedded items, furnished under those sections and installed here.
   2. Supervise setting of dowels for masonry furnished and installed under Section 03200, Reinforcing Steel.

1.3 RELATED WORK (SEE ALSO TABLE OF CONTENTS):

A. Reinforcing Steel: Section 03 20 00.

B. Cast-in-Place Concrete: Section 03 30 00.

C. Mortar and Grout: Section 04 05 00.

D. Structural Steel: Section 05 12 00.

E. Miscellaneous Metal: Section 05 50 00.

1.4 QUALITY ASSURANCE

A. Allowable Tolerances: Maximum deviation from indicated line or plane of installed concrete masonry units shall not exceed 1/8 inch in 10 feet in any direction.

B. Standards and References: (Latest Edition unless otherwise noted):
   1. 2022 California Building Code (CBC)
   2. ASTM C90 - Hollow and Solid Load Bearing Concrete Masonry Units
   3. ASTM C140 - Sampling and Testing of Concrete Masonry Units
   4. ASTM C426 - Standard Test Method for Drying Shrinkage Concrete Block.
   5. CBC Section 2103.1.
   6. Concrete Masonry Design Manual published for the Concrete Masonry Association of California and Nevada, current Edition.
   7. Masonry Standards Joint Committee (MSJC)

C. Submittals: Refer to Section 01040 for submitting the following items:
   1. Suppliers certificate indicating units comply with material standards indicated below:
   2. See Section 03200 for reinforcing steel submittals.

D. Tests and Inspections:

1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the 2022 CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
2. All tests and inspections herein are to be performed by an independent testing laboratory approved by the Building Official.
3. If masonry tests are indicated as required on the structural drawings, three sample units will be tested during construction for each 5,000 square feet of wall area. Test also three sample units prior to construction.
   a. Units will be tested for compressive strength on both the net and gross area per ASTM C140.
   b. Units will be tested for linear drying shrinkage per ASTM C426.
4. If masonry placement and grouting inspection is indicated as required on the structural drawings, a special inspector shall be employed per CBC Section 1704 to inspect the placement of all units, placement of all reinforcing steel, during all grouting operations and during taking of all test specimens.
5. See Section 03200 for reinforcing steel tests and inspections.

1.5 PRODUCT HANDLING

A. Scaffolding, runways and ladders required for work under this Section shall be provided by masonry contractor, and shall be heavy trades type substantially built and in compliance with State labor laws, safety codes and other regulatory agencies as applicable to this project.

B. Environmental Requirements: Install concrete unit masonry when temperature in area surrounding work is 40° F or above. Maintain temperature of work above 40° F for at least 48 hours after installation. Grout shall not be placed when air temperatures fall below 20° F.

C. Store masonry units off the ground in a dry location, covered and protected from absorbing moisture.

PART 2 - PRODUCTS

2.1 MASONRY UNITS

A. Masonry units shall be hollow load bearing masonry units conforming to ASTM C90 and CBC Section 2103.1.
   1. Weight: Light weight.
   2. Maximum lineal shrinkage from saturated to oven dry condition of not more than 0.065 percent.
   3. Twenty-eight day compressive strength of 1000 psi on gross area and 1900 psi on net area.
   4. Moisture controlled units.

B. Unit Type
   1. 8" wide by 8" high x 16" long unless specified otherwise.

C. Provide bond beam units, open end units and other special units as indicated. Use open end units at cells containing vertical reinforcement wherever possible.

D. Masonry Openings

1. Provide closed end units around all exposed openings. Open end units will not be allowed at exposed openings.

E. Finish
1. Block shall have splitface finish at all exposed exterior areas; color and finish shall match Basalite
2. D113 Split-Face, with no exceptions.
3. Block shall have smooth finish at exposed interior areas where scheduled on the Drawings; color and finish shall match Basalite D113, with no exceptions.
4. Block shall have smooth finish at non-exposed exterior and interior areas; color and finish shall match Basalite D113 where exposed, and D113 or 225 where not exposed.

2.2 MORTAR AND GROUT

A. Specified under Section 04050.

2.3 ACCESSORY MATERIALS

A. Reinforcing Bars: ASTM A615, Grade 40 or 60, as indicated in Section 03 21 00, deformed bars.
1. Tie Wire: Black annealed steel wire not lighter than 16 gage.

B. Provide spacers to firmly hold reinforcement in place.

C. Anchor Bolts: All anchor bolts cast in masonry shall be headed bolts with cut threads conforming to ASTM A307 or ASTM A36 or ASTM A572.50 as indicated on drawings.

D. Expansion Anchors: All expansion bolts installed in masonry shall be Hilti Kwik Bolt 3 as manufactured by Hilti Inc. See Structural Drawings for installation requirements and tension testing requirements as applicable. See Drawings for special head requirements as needed. Substitution of other brands or anchors shall proceed only after written approval from the Structural Engineer and the Building Official as been obtained.

2.4 JOINTS

A. All joints shall be 3/8” thick joints for concrete block, Tool exposed interior and exterior joints and concealed exterior joints to produce a dense slightly concave surface that is well bonded to unit at edges. Tool joints behind room base, switches, and outlet plates to produce a smooth dense joint flush with the face of adjacent masonry units, where occurring on the job. Cut joints flush on concealed interior surfaces and surfaces to be plastered.

2.5 SEALER

A. Contractor shall provide and install minimum two coats, Thoroseal masonry sealer at all CMU walls. Thoroseal product shall meet all state vapor requirements. Sealer shall be clear and non-gloss product.

2.6 ANTI-GRAFFITI COATING

A. Exterior two-coat application, for Graffiti Removal and Control; Sherwin-Williams Pro Industrial Anti-Graffiti Coating, non-sacrificial coating, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive masonry and verify following:
1. That foundation surface is level to permit bed joint with range of 1/4 to 3/4 inch.
2. That edge is true to line to permit projection of masonry to less than 1/4-inch.
3. That projecting dowels are free from loose scale, dirt, concrete, or other bond-inhibiting substances and properly located.

B. Do not begin work before unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean concrete surfaces to receive masonry. Remove latence or other foreign material lodged in surfaces by sandblasting or other means as required. Joints between concrete and masonry shall be considered construction joints. See Concrete specifications.

B. Ensure masonry units are clean and free from dust, dirt, or other foreign materials before laying.

C. Establish lines, levels, and coursing. Protect from disturbances.

D. Provide temporary bracing during erection of masonry work. Maintain in place until masonry has set to provide permanent bracing.

3.3 COURSING

A. Erect masonry in accordance with CBC Section 2104.1.2.

B. Place masonry to lines and levels indicated to the following tolerances:
1. Variation from Unit to Adjacent Unit: 1/32-inch max.
2. Variation from Plane of Wall: 1/4-inch in 10 feet.
3. Variation from Plumb: 1/4-inch.
4. Variation from Level Coursing: 1/8-inch in 3 feet; 1/4-inch in 10 feet; ½-inch maximum.
5. Variation of Joint Thickness: 1/8-inch in 3 feet.

C. Bond: Unless noted otherwise in Drawings, lay concrete masonry units in running bond with vertical joints located over score of unit in course below (and vice versa).

D. Maintain masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness.

E. Preserve the vertical continuity of cells in concrete unit masonry. The minimum clear horizontal dimensions of vertical cores shall be 3 x 3 inches for 8-inch wide block.

3.4 PLACING AND BONDING

A. Do not install cracked, broken or chipped masonry units.

B. Lay only dry concrete masonry units.

C. C. Lay masonry in full bed of mortar, properly jointed with other work. Buttering corners of joints, and deep or excessive furrowing of mortar joints are not permitted.
   1. Block Cap: Lay with full mortar coverage on horizontal and vertical joints.
   2. Install grout cap where and as indicated.

D. Fully bond intersections and external and internal corners.

E. Do not shift or tap masonry units after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.

F. Remove excess mortar.

G. Perform job-site cutting with proper tools to provide straight unchipped edges. Take care to prevent breaking masonry unit corners or edges.

H. Step back unfinished work for joining with new work. Do not use toothing.

3.5 JOINTS

A. Horizontal and vertical joints at masonry units shall be 3/8-inch wide and as follows:
   1. Point joint tight in unpurged masonry below ground.
   2. All end joints shall be fully filled with mortar and joints squeezed in bed joints shall be held back approximately ½-inch from cell to provide positive bond with grout.
   3. Joints shall be struck flush at all areas to receive plaster finish.

3.6 MASONRY REINFORCEMENT

A. Place reinforcement in accordance with ACI 315, to a tolerance of +/- ½-inch from specified location.

B. Reinforcing steel shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the plans shall not be used. Heating of bars for bending will not be permitted.
   1. Bars shall conform accurately to the sizes, shapes, lines and dimensions shown on drawings and with hooks and beds made as detailed. Bars shall be placed as indicated on the drawings and centered on grout space.
   2. At the time grout is place around it, reinforcing steel shall be clean of mill scale or other coatings that will destroy or reduce bond.
   3. All vertical reinforcing steel shall be installed in one piece, full height of wall, and braced throughout its height in a manner that will retain the steel in proper position and provide the proper clearance.

C. Reinforcing steel shall be secured to all foundation dowels and held in place at spacings not to exceed 192 bar diameters.

3.7 GROUTING

A. General Requirements:
   1. All cells shall be grouted solid.
   2. Use low lift or high lift grouting at Contractor's option.
   3. Use grout pump, hopper or bucket to place grout.
   4. Place grout in final position within 1-1/2 hours after introduction of mixing water.

5. Place grout and rod with a 3/4-inch flexible cable vibrator sufficiently to case it to flow into all voids between the cells and around the reinforcing steel. Slushing with mortar will not be permitted.
6. Stop grout approximately 1½ inches below top of last course; except at top course bring grout to top of wall.

B. Low Lift Grouting:
1. Do not lay units higher than 64 inches before grouting.
2. If mortar has been allowed to set prior to grouting, remove all fins protruding more than ½-inch into grout space.
3. Conform to requirements of CBC Section 2104.6.1.1.2.
4. Consolidate each lift twice. Once while placing grout and once more after initial absorption of water but before set.

C. High Lift Grouting:
1. Conform to requirements of CBC Section 2104.6.1.1.3.
2. Lay up walls, subject to maximum height limitations of Masonry Standards Joint Committee, Building Code Requirements for Masonry Structures Table 1.16.1.
3. Provide clean out holes at the bottom of every pour in cells containing vertical reinforcement. Construct clean out courses with open-bottom bond beam units inverted to permit cleaning of all cells by flushing. Cleanouts shall be not less than 3x4inch openings cut from one face shell. Do not plug clean out holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected.
4. Clean mortar droppings from the bottom of the grout space and from reinforcing steel. Remove mortar fins protruding more than ½-inch into the grout space by dislodging the projections with a rod or stick as the work progresses or by washing the grout space at least twice a day during erection using a high pressure stream of water.
5. Do not place grout in hollow unit masonry until mortar joints have set for at least 72 hours and clean out plugs have cured 48 hours.
6. Place grout in lifts not to exceed 4 feet in height, with a waiting period between lifts, dependent on weather and absorption rate of the masonry, in order to place the succeeding lift after the preceding lift becomes plastic but prior to initial set. The first lift shall be consolidated using mechanical vibrators. After the required waiting period, place the second lift and consolidate with the vibrator, reconsolidating the lift below to a depth of 12 to 18 inches. Repeat the waiting, placing and consolidating process until the top of the grout pour is reached. Reconsolidate the top lift after the required waiting period. The high-lift grouting of any section of wall between lateral flow barriers shall be completed to the top of a pour in one working day unless a new series of clean out holes is established and the resulting horizontal construction joint cleaned.

3.8 WEATHER PROVISIONS FOR CONSTRUCTION

A. Cold Weather Construction to be in accordance with CBC section 2104.3.

B. Hot Weather Construction to be in accordance with CBC section 2104.4

3.9 EXPANSION JOINTS

A. See drawings for type and location of expansion joints.

3.10 BOND BEAMS

A. Bond beams shall be located where shown and detailed on the drawings, and shall be reinforced as indicated and as herein after specified.

3.11 BUILT-IN WORK

A. Miscellaneous Embedded Items: All items indicated to be embedded in masonry shall be carefully located and anchored to prevent movement during grouting operations. Avoid cutting and patching.
   1. Install all anchor bolts and anchors furnished under other sections for wood nailers, ledgers, etc.

3.12 CUTTING AND FITTING

A. Obtain approval prior to cutting or fitting any area not indicated or where appearance or strength of masonry work may be impaired.

3.13 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damage, or if units do not match adjoining units.

B. Pointing: During the tooling of joints, enlarge any voids or holes and completely fill with mortar.

C. Dry brush masonry surface after mortar has set, at each day's work and after final pointing.

D. Leave work and surrounding surface clean and free of mortar spots and droppings.

E. Cleaning: Upon completion of masonry installation, repair all holes. Defective joints shall be cut out and rejointed. Exposed masonry surfaces shall be cleaned free of mortar, green stain and effloresence.

3.14 SEALER

A. Contractor shall install sealer as directed by the manufacturer. Coverage and installation rates shall be as per manufacturer’s recommendations. Install sealer in minimum two coats at the rates required.

3.15 ANTI-GRAFFITI COATING

A. Anti-Graffiti Coating shall be done after installation of joint sealant specified in Section 07920.

B. Surface preparation: Masonry must be clean, dry and free of excess dust and mortar. New masonry surfaces must be allowed to cure for 10 days prior to application under normal weather conditions. After a rain, allow at least three days for masonry to dry thoroughly; do not apply if rainfall is anticipated within 24 hour cure cycle. Mask adjacent areas to protect from overspray.

C. Application: Follow manufacturer's written direction for additional details.

D. Coverage: Apply at average rate not to exceed manufacturer's written direction. Apply full-height of masonry, or to a minimum height of 20’-0” above adjacent finish grade.

3.16 DEFECTIVE MASONRY

A. Materials or workmanship not conforming to appearance or strength specified, will be deemed defective and shall be removed and replaced at no cost to Owner.

B. Defective mortar and grout, as defined under Section 04050; “Mortar and Grout” shall constitute defective masonry.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all Work of this Section.

1.2 SCOPE

A. Furnish and install all structural steel as shown and specified including, but not necessarily limited to the following:
   1. Prime coat painting and touch up.
   2. All cast-in-place anchor bolts, nuts, plates, etc.
   3. 10 gauge steel or 3/4 inch plywood templates for column anchor bolts.

1.3 RELATED WORK (SEE ALSO TABLE OF CONTENTS)

A. Metal Decking: Section 05 30 00.

B. Metal Fabrications: Section 05 50 00.

C. Cast-In-Place Concrete: Section 03 30 00.

1.4 QUALITY ASSURANCE

A. General:
   1. Comply with the referenced ASTM standards for materials.
   2. Perform all welding only with AWS certified welders.
   3. Verification of accuracy:
      a. Engage and pay for a registered civil engineer or licensed land surveyor to check the alignment, plumbness, elevation, and overall accuracy of the erected framing at appropriate stages during construction and at completion of erection. Prior to erection, a survey shall be made of the as-built locations of all anchor rods and other embedded items associated with the attachment of structural steel. The party providing the survey shall submit written verification that the entire installation is in accordance with the contract documents and meets the allowable erection tolerances as set forth in the AISC "Code of Standard Practice for Steel Buildings and Bridges".
      b. Columns shall be verified at each lift. Column shim details and procedures shall be submitted for review.
   4. Paint:
      a. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use thinners approved by paint manufacturer, and use within recommend limits.
      b. Coordination of Work: Review other Sections in which prime paints are to be provided to ensure compatibility of coatings system for various substrates. Upon request, furnish information or characteristics of finish materials to be used.

c. Requirements of Regulatory Agencies: Comply with applicable rules and regulations of governing agencies for air quality control.

B. Except where other requirements are specified, comply with the following standards by American Institute of Steel Construction (AISC) and American Welding Association (AWS):
1. AISC 360-22 "Specification for Structural Steel Buildings".
2. 2016 AISC "Code of Standard Practice for Steel Buildings and Bridges".
3. AISC 341-22 “Seismic Provisions for Structural Steel Buildings”
4. AISC 358-22 “Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications”
5. AISC "Specifications for Structural Joints Using A325 or A490 Bolts".
6. AISC Section 10, Architecturally Exposed Structural Steel, Code of Standard Practice for Steel Buildings and Bridges
7. AWS D1.1 "Structural Welding Code".
8. ASTM A6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
9. SSPC-Vis 1 Pictorial Surface Preparation Standards for Painting Steel Structures
10. SSPC-SP2 Hand Tool Cleaning
11. SSPC-SP3 Power Tool Cleaning
12. SSPC-SP6 Commercial Blast Cleaning
13. SSPC-PA2 Measurement of Dry Paint Thickness with Magnetic Gauges
14. 2022 California Building Code (CBC).

C. Submittals: (Submit under provisions of Section 01040)
1. Product Data: Include laboratory test reports and other data to show compliance with specifications (include specified standards). Include certified copies of mill reports covering chemical and physical properties of each type of structural steel.
2. Shop Drawings:
a. Shop drawings shall include complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.
b. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.
c. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.
d. Dimensions required to locate structural steel for manufactured items such as mechanical equipment, electrical equipment, dock levelers, etc., shall be coordinated and provided by the General Contractor. General Contractor shall also coordinate and provide dimensions to locate structural steel for window washing supports such as davits, tie-backs, etc.
3. Procedures:
a. Provide weld procedures for both pre-qualified welds and special welds to be submitted to the Owner's Testing Laboratory and the Architect.
b. Provide installation procedure and inspection for direct tension indicator washers detailed in supplemental specifications provided by the manufacturer for approval.
c. Procedures shall be submitted for both shop and field welds.

D. Tests and Inspections:
1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the 2022 CBC requirements and in collaboration with Testing

Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.

2. Testing Laboratory:
   a. An inspection and testing laboratory will be selected by the Owner for testing and inspection as required by the Contract Documents. The selected laboratory shall conform to the requirements of ASTM E329 (Recommended Practice for Inspection and Testing Agencies used in Construction). Documentary evidence of such conformance shall be submitted to the Owner and the governing agency.
   b. All materials, work, methods and equipment shall be subject to inspection at the mill, fabricating plant and at the building site. Material or workmanship not complying fully with the Contract Documents will not be accepted. The Contractor shall give the Testing Laboratory reasonable notice when ready for inspection and shall supply samples and test pieces and all facilities for inspection without extra charge. The Owner will assume the expense of making the tests and inspection except as otherwise specified in Division 1.
3. Cost of Testing and Inspection: Costs of testing and inspection of structural steel, except as specified hereunder and in Division 1, will be paid for by the Owner.
   a. All transportation costs and per diem living costs for inspection at fabricators' plant further than 75 miles from the job site will be back-charged to the Contractor.
   b. It is assumed that all fabrication will take place in one shop location only. All additional inspection costs will be back-charged to the Contractor.
   c. All mill tests and costs of re-test of plain materials shall be at the expense of the Contractor.
   d. Costs of tests required due to Contractor's failure to provide steel identifiable in accordance with the indicated ASTM designation shall be at the expense of the Contractor.
4. Structural Steel Testing and Inspection:
   a. Structural Steel: If structural steel tests are indicated as required on the structural drawings, one tension and one bend test shall be made for each size of structural shape, plate and for each tube and pipe size. Tests to be made in accordance with requirements of appropriate ASTM designations.
   b. If structural steel tests are not indicated as required on the structural drawings, then for shapes, plates, bars, pipe and tubing, manufacturer's certified mill test reports and analysis for each heat will be acceptable for steel identifiable in accordance with indicated ASTM designation. Mill test reports shall indicate the physical and chemical properties of all structural steel used. Correlate individual heat numbers with each specified structural section.
   c. Unidentifiable Steel:
      1) For Fy less than or equal to 36.0 ksi : Provide one tension and elongation test and one bend for each 5 tons or fraction thereof for each size.
      2) For Fy greater than 36.0 ksi : Provide one tension and elongation test and one bend or flattening for each piece.
   d. Costs of retests and additional testing required by the use of unidentifiable steels shall be the Contractor's responsibility. Additional costs of testing incurred by the Owner shall be deducted from the Contract Final Payment.
5. Expansion Anchors: Load test as indicated on drawings.
6. Welding Inspection:
   a. If shop or field welding inspection is indicated on the structural drawings, all shop and field welded operations will be inspected by a qualified welding inspector employed by the Testing Laboratory. Such inspector will be a person trained and

thoroughly experienced in inspection of welds. The inspector's ability to distinguish between sound and unsound welding will be reliably established

b. The welding inspector will make a systematic record of all welds. This record shall include:
   1) Identification marks of welders.
   2) List of defective welds.
   3) Manner of correction of defects.

c. The welding inspector will check the material, equipment and procedure, as well as the welds. He will also check the ability of the welder. He will furnish the Architect with a report, duly verified by him that the welding which is required to be inspected is proper, and has been done in conformity with the Contract Documents, and that he has used all means to determine the quality of the welds.

d. All full penetration groove welds will be subject to ultrasonic testing, as per AWS D1.1, Section 6 "Inspection, Part "C", Ultrasonic Testing of Groove Welds. All defective welds shall be repaired and retested with ultrasonic equipment at the Contractor's expense.

e. Column Flanges: An area extending 6 inches above and below point where girder flanges are attached will be inspected. Column flange edges will be inspected visually, and entire area ultrasonically for lamination, plate discontinuities, and non-metallic inclusions.

f. All partial penetration groove welds shall be tested by ultrasonic testing.

g. When ultrasonic indications arising from the weld root be interpreted as either a weld defect or the backing strip itself, the Engineer will be notified. The Engineer may require the removal of backing strip. The backing strip will be removed at the expense of the Contractor, and if no root defect is visible the weld will be retested. If no defect is indicated on this retest, and no significant amount of base and weld metal have been removed, no further repair of welding is necessary. If a defect is indicated, it will be repaired and retested at Contractor's expense.

h. The ultrasonic instrumentation will be calibrated by the technician to evaluate the quality of the welds in accordance with AWS D1.1.

i. Other methods of inspection, for example, X-Ray, gamma ray, magnetic particle, or dye penetrant, may be used on welds if felt necessary by the inspection laboratory, and with the approval of the Engineer.

j. Base metal thicker than 1-1/2 inches, when subjected to through thickness weld shrinkage strains, shall be ultrasonically inspected for discontinuities directly behind such weld before and after joint completion.

k. End-welded studs shall be sampled, tested, and inspected per the requirements of the Structural Welding Code - Steel D1.1 Chapter 7, published by the American Welding Society.

l. At the discretion of the owner's testing agency, the ultrasonic testing frequency may be reduced but may not be less than the following:

m. Initially, all welds requiring ultrasonic testing will be tested at the rate of 100 percent in order to establish the qualifications of each individual welder. If the reject rate is demonstrated to be less than 5 percent of the welds tested for each welder, then the frequency of testing for that welder may be reduced to 25 percent. If the reject rate increases to 5 percent or more, 100 percent testing will be re-established until the rate is reduced to less than 5 percent. The percentage of rejects will be calculated for each welder independently.

n. A sampling of a least 40 completed welds will be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects divided by the number of welds completed. For evaluating the reject rate of continuous welds over 3' in length, each 12 linear inch increment of welds, 1

inch or less in thickness, will be considered as one weld. For evaluating the reject rate of continuous welds greater than 1 inch thickness, each 6 linear inches will be considered one weld.

1.5 PRODUCT HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

B. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 SEQUENCING/SCHEDULING

A. Cooperate and coordinate this work with other trades for anchor bolts, and other required inserts, templates, etc. Align this work prior to installation of other materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel: Except where indicated on drawings.
1. W shapes: ASTM A572-50 or ASTM A992-50 unless indicated otherwise on drawings.
2. Channels and other rolled shapes: ASTM A36 unless indicated otherwise on drawings.
3. Angles, plates and bars: ASTM A36 unless indicated otherwise on drawings.

B. AISC group 4 and 5 shapes and plates greater than 2 inches thick: ASTM A36 and/or ASTM A572 Grade 50 with supplementary requirements S91 Fine Austenitic Grain Size and S5 Charpy V-Notch Impact Test. For location of Charpy V-Notch test, see ASTM A6 Supplementary Requirement S30. Charpy V-Notch test shall be per ASTM A673, frequency P and shall meet a minimum average value of 20 ft-lbs absorbed energy at 70^{o} F.

C. Cold-Formed Steel Tubing: ASTM A500, Grade B.

D. Steel Pipe: ASTM A53, Type E or S, Grade B.

E. Anchor Bolts: All anchor bolts cast in concrete or masonry shall be headed bolts with cut threads conforming to ASTM F1554 grade 36, 55 or 105 as indicated on drawings.

F. Machine Bolts: ASTM A307.

G. Headed Stud-Type Shear Connectors: ASTM A108 Grade 1015 or 1020 Cold-finished carbon steel with dimensions complying with AISC Specifications.
1. Tensile strength, 60,000 psi.
2. Elongation in 2 inches, 20 percent
3. Reduction of area, 50 percent.

H. Provide hexagonal heads and nuts for all connections per ASTM A563, Appendix Table X1.1.

I. Electrodes for Welding: Comply with AWS Code, E70 Series minimum. Fabricator to select proper electrodes according to weld procedures as submitted.

J. Shop Primer:
1. Type A Material: Tnemec Company, Inc., 88HS
2. Type B Material: Tnemec Company, Inc., 90-97 Tneme-Zinc.
3. All paints shall meet the California Air Resources Board Standards.
4. Finish paint Material (uno): Tnemec Company, Inc., Series 75- Endura-Shield. Color to be selected by owner.

K. Powder Driven Fasteners: Tempered steel pins with special corrosive resistant plating or coating. Pins shall have guide washers to accurately control penetration. Fastening shall be accomplished by low-velocity piston-driven power activated tool. Pins and tool shall be as manufactured by Hilti Fastening Systems.

L. Expansion Bolts: Hilti Fastening Systems “Kwik-Bolt Concrete Expansion Anchors” to concrete; Ramset “Dynabolt Sleeve Anchors” to masonry or approved equal.

PART 3 - EXECUTION

3.1 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assembly structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated to provide the flattest floor possible. The contractor shall coordinate member tolerances with finishes.

Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections, as indicted. Bolt field connections, except where welded connections or other connections are indicated.

C. Unless noted otherwise, make holes 1/16 inches larger than the nominal bolt diameter.

D. Welding, Shop and Field: Weld by shielded arc method, submerged arc method, flux cored arc method, or other method approved by AWS. Perform welding in accordance with AWS Code. All welders, both manual and automatic, shall be certified in accordance with AWS "Standard Qualification Procedure" for the Work to be performed. See paragraph "welding" herein, for detailed requirements. If sizes of fillet welds are not shown on drawings, use AWS minimum weld size but not less than 3/16 inch fillet welds.

E. Bolt Holes for Other Work: Provide holes required for securing other work to structural steel framing.

Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.

Cut, drill, or punch holes perpendicular to metal surfaces and remove all burrs. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

F. AISC Group 4 and 5 shapes and built up members shall meet the requirements for joints in AISC Sections J1.7, J1.8, J2.6 and M2.2.

3.2 WELDING

A. General: Quality of materials and design and fabrication of all welded connections shall conform to AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Building," "AWS Code for Welding in Building Construction," and requirements of this section.

Location and type of all welds shall be as shown. Make no other welded splices, except those shown on drawings, without prior approval of the architect.

B. Automatic Welding: Use electrode wire and flux for automatic and semi-automatic welding acceptable to Structural Engineer. All methods, sequences, qualification and procedures, including preheating, and post heating if necessary, shall be detailed in writing and submitted to the Structural Engineer for review.

C. Qualification of Welders:
1. Structural steel welding: Manual and automatic welds for structural steel construction shall be made only by operators who have been previous qualified by tests, as prescribed in AWS D1.1 to perform type of work required.
2. Welders shall be checked by welding inspector. Those not doing satisfactory work may be removed, and may be required to pass qualification tests again. All qualification testing shall be at the Contractor's expense.
3. Only welders whose weld procedures and pre-qualification by testing that have passed shall be considered qualified for such welds.

D. Control cooling process after weld is completed by either step down post heat or thermal blankets as determined by procedures and prequalification.

E. Box columns and built-up members shall have ultrasonic testing before and after welding.

F. Flame cut surfaces shall be ground to remove contaminated steel layer to provide welds proper fusion without impurities.

G. Preparation of surface: Surfaces to be welded shall be free of loose scale, slag, rust, grease, paint, and any other foreign material.

H. Welding equipment: Welding equipment to be used in each case shall be acceptable to welding inspector. Use equipment with suitable devices to regulate speed, and manually adjust operating amperage and voltage. The amperage capacity shall be sufficient to overcome line drop, and to give adequate welding heat.

I. Remove runoff tabs and grind surfaces smooth where the tabs would interfere with fireproofing and architectural finishes.

J. End-welded studs:

1. Automatic end-welded studs: Automatically end-weld in accordance with the manufacturer's recommendations in such a manner as to provide complete fusion between the end of the stud and the plates. There shall be no porosity or evidence of lack of fusion between the welded end of the stud and the plate. The stud shall decrease in length during welding approximately 1/8 inch for 5/8 inch, and 3/16 inch for 3/4 inch diameter. Stud sizes indicated on drawings represent the finish stud height.
2. Fillet-end welded studs: Studs may be welded using prequalified FCAW, GMAW, or SMAW processes provided the requirements of the AWS D1.1 Chapter 7 Section 7.5.5 are met as well as any other pertinent requirements of D1.1.

K. Provide mill camber as shown on the construction documents within AISC tolerance. Place mill tolerance upward for all beams specified no camber.

3.3 ERECTION

A. Structural steel erection: Comply with AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Building", latest edition.

B. Erection Sequence: Erect steel in accordance with special erection sequences where special erection sequences are indicated on the contract documents.

C. Before and during erection, keep all structural steel clean. Ship, handle and store steel in manner to avoid injury to members. Steel members showing evidence to rough handling or injury will be rejected.

D. Mark each member with erection identification corresponding to mark shown on erection drawings. Carefully plan erection of structural steel so that no cutting and removal of material will be necessary. Do not torch burn in the field, unless specifically permitted by Engineer.

E. Provide sufficient bracing, shoring and guys to effect safe and satisfactory erection. Provide bracing and shoring capable of holding steel work plumb and properly aligned while field connections are being made, and until lateral force resisting elements are deemed by Architect capable of bracing structure. Temporary bracing shall be adequate to resist lateral forces from wind or seismic prior to the completion of the lateral resisting system.

F. Set bearing and base plates with extreme care. Bring level, to line and grade with leveling plates or by leveling nuts and bolts. Grout solid under plates with a flowable non-shrink grout per Section 03 30 00 prior to applying vertical load.

G. Field Assembly: Set structural framing accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces which will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

Shimming or other adjustments not indicated on drawings shall be approved by the Engineer prior to installation. Level and plumb individual members of the structure within specified AISC tolerances except as noted herein. Column shimming shall be 1/4 inch.

H. All welds shall be full and clean, and conform to AISC and AWS specifications.

I. Erection Tolerances: Individual pieces shall be erected so that the deviation from plumb, level and alignment shall not exceed 1 to 500 plus:
   1. The maximum displacement of the center line of columns adjacent to elevator shafts, from the established column line, shall not be more than 1 inch at any point.
   2. In order to provide a true, flat plane for the exterior elevations, install all steel framing at the exterior walls of the building, so that the center lines of such framing does not vary by more than 1 inch for the length of the building. Also install each vertical member on such grids so that its vertical center line does not vary by more than 1/2 inch from a vertical line for each story and 1 inch for its full height.
   3. All columns and beams shall adhere to Section M2.7 of the referenced "Specification for Structural Steel for Buildings" which states that completed members shall be free of twists, bends, and open joints. Take special care that column base plates are parallel and perpendicular to faces of columns and that bolt holes are accurately placed.

J. Temporary Flooring:
   1. Provide planking and scaffolding necessary in connection with erection of structural steel, support of erection machinery, and construction materials. Temporary floors and use of steel shall be as required by applicable regulatory requirements.
   2. If steel decking is used as a working platform, it shall be temporarily tack-welded to supports to extent necessary for such use in accordance with applicable regulatory requirements. The concentrated loading from welding machines and other heavy machinery required for steel erection shall be distributed by planking or other approved means. Metal decking that becomes damaged as the result of being used as a working platform shall be replaced at no additional cost to the Owner.
   3. Tower Crane: The design for the support and bracing for a tower crane shall be the responsibility of the General Contractor. The design shall be prepared by a structural engineer licensed in the state of California. Drawings and calculations shall be stamped and signed by the structural engineer. Concentric, torsional, and/or eccentric loading to the main structure shall be resolved by the addition of structural steel for shear tabs, stiffeners, drag ties, bracing struts, etc., Such items shall be designed, detailed, furnished and installed by the contractor.

3.4 PAINTING AND CLEANING

A. Prior to prime coat application, clean all loose rust, mill scale, oil, dirt, and all other materials from all steel to be left exposed. Use hand tool, power tool, sandblasting, chemical cleaning, and any other method necessary to provide a smooth, sound surface for painting.

B. Shop prime all steel except the following:
   1. Steel encased in concrete.
   2. Contact surfaces for slip-critical (sc) high strength bolts.
   3. Areas within 4 inches of field welds.
   4. Tops of members to receive metal decking.
   5. Steel to be fireproofed.
   6. Surfaces to be galvanized.

C. Use the following Type A shop painting systems on all normal environment interior steelwork:
   1. Surface Preparation: SSPC-SP2 Hand Tool Cleaning or SSPC-SP3 Power Tool Cleaning. Where jobsite exposure is expected to exceed 6 months, SSPC-SP6 Commercial Blast Cleaning is required.
   2. Application: Follow coating manufacturer's printed directions.

3. Material: Type A Tnemec Series 88HS Azeron Primer.
4. Number of Coats: One
5. Dry Film Thickness: 2.0 mils minimum.
6. Volume Solids: 60.0 +/- 2.0% minimum
7. Generic Description: Modified Alkyd.

D. Use the following Type B shop painting systems on all exterior steelwork and interior steelwork subjected to wet conditions or fumes:
1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning
2. Application: Follow coating manufacturer's printed directions.
3. Material: Type B Tnemec 90-97 Tneme-Zinc primer
4. Number of Coats: One
5. Dry Film Thickness: 2.5 mils minimum.
6. Volume Solids: 63% +/- 2%
7. Generic Description: Organic Zinc-Rich Urethane

E. Use the following finish painting systems on all exterior steelwork and interior steel work subjected to wet conditions or fumes:
1. Application: Follow coating manufacturer’s printed directions. Apply over Type B primer system above.
2. Material: Tnemec Series 75 Endura-Shield paint.
3. Number of Coats: One
4. Dry Film Thickness: 3 to 5 mils
5. Volume Solids: 72% +/- 2%
6. Generic Description: Aliphatic Polyurethane

F. Apply two shop prime coats to areas which will be inaccessible after erection.

G. Clean contact surfaces of high strength bolts of all burrs and material which might prevent solid seating of the parts. Steel to receive bolts shall be primer painted except beneath the contact area of slip-critical bolts.

H. After erection, field touch up all welded areas, high strength bolts and damaged areas. For all steel to remain exposed, remove all blemishes, paint drips, and touch up prime coat.

3.5 HOISTING AND BRACING

A. Provide all hoisting and erecting equipment and power.

B. Provide and maintain any and all safety railings, toe boards, etc., required for the erection of steel framing and metal decking.

C. Brace the erected frame in a manner which will assure safety and proper alignment to receive the metal decking and until the concrete slabs have been poured and have set.

D. Erect building frame true and level. Erect columns in a manner to allow for movement due to welding shrinkage and thermal expansion and contraction of framing. Check plumbness after erection of each level. Maintain structural stability of frame during erection. Provide temporary bracing where necessary to maintain frame stability and to support required loads, including equipment and its operation.

END OF SECTION

SECTION 05 30 00

METAL DECKING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of Division 1 apply to all Work of this Section.

1.2 SCOPE

A. Provide all steel decking, accessories and cutting and reinforcing of all holes as indicated on Drawings and specified here.

1.3 RELATED WORK (SEE ALSO TABLE OF CONTENTS):

A. Cast-in-place concrete: Section 03 30 00.

B. Structural Steel: Section 05 12 00.

C. Metal Fabrications: Section 05 50 00.

D. Holes for Mechanical and Electrical Work: Divisions 15 and 16.
1. Cutting and reinforcing of holes for plumbing and electrical conduits shall be part of this work providing holes are located by the mechanical and electrical contractors prior to or during installation. Cutting and reinforcing of holes after installation shall be the responsibility of those trades requiring them.
2. Miscellaneous connection requirements for Mechanical and Electrical Work: Divisions 15 and 16.

1.4 QUALITY ASSURANCE

A. Standards and References: (Latest Edition unless otherwise noted)
1. 2022 California Building Code (CBC)
2. American Iron and Steel Institute (AISI). "Specification for the Design of Cold-Formed Steel Structural Members."
3. American Welding Society (AWS): AWS D-1.3 "Structural Welding Code - Sheet Steel".

B. Submittals: (Submit under Provisions of Section 01040)
1. Shop Drawings. Submittal required. Indicate deck sheet layout and all installation details. Contract documents may not be used as shop drawings.
2. Manufacturer's specifications for each Deck Type. Submittal required.
3. Certification: Provide affidavits from the manufacturer listing mill test certificates by number for each size and type of decking.
4. Manufacturer shall provide affidavits of approval by the International Code Council Evaluation Service (ICC-ES) for the metal decking shapes proposed.
5. Floor areas to receive concrete fill over metal deck: Provide a work plan detailing the means and methods to be used for placement of concrete, including screeding procedures and locations of any construction joints, which will achieve the performance

criteria noted in Section 2.1. A pre-construction meeting shall be scheduled by the General Contractor, to include the concrete sub-contractor, Architect, Structural Engineer, and Owner's Representative to discuss the work plan and performance objectives.

C. Tests and Inspections:
1. A testing program is required prior to start of construction. Testing program to be done In Compliance with the 2022 CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
2. All materials, methods and equipment shall be subject to inspections by the Testing Laboratory at any time.
3. Material Testing: Test reports establishing conformity to the specifications shall be furnished to the Owner for each heat prior to installation.
4. Welding Inspection: Welding of metal deck shall be performed under the inspection of the Testing Laboratory. Inspection shall conform to CBC Section 1704.
5. Powder Actuated Fasteners (shotpins): Where decking is attached with shotpins, the pins shall be inspected for proper installation by a special inspector. Twenty-five percent (25%) of all pins shall be verified using the inspection tool supplied by Hilti Inc.

1.5 PRODUCT HANDLING

A. Protect metal decking before installation and protect the installed work and materials of other trades.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS - DECK SYSTEMS

A. Acceptable Manufacturers:
1. ASC Steel Deck.
2. Verco Manufacturing Co.
3. Manufacturers of materials are indicated to set a standard for design and product performances.
4. Subject to the requirements of Division 1, products of manufacturers not indicated may be proposed for substitution, provided that they are equal in design, product performance and warranty to the products specified and have ICBO approval.
5. The burden of proof of equality of proposed products is on the Contractor.

B. Provide deck sections, type and gage as indicated on the drawings. Other manufacturers producing deck complying with these Specifications, and having equivalent properties and dimensions will be subject to the Architect's review upon submission of substantiating data, and may be used only if equivalent to deck sections specified, in the Architect's opinion.

C. All deck units shall be approved by International Code Council Evaluation Service (ICC-ES) for use as a diaphragm.
1. Diaphragm shear capacities shall be comparable (within 5%) to those listed on the drawings for the deck, welding, and spans indicated.

D. Units shall be in lengths to span two or more supports. Where steel layout does not permit two-span minimums, notify the Structural Engineer prior to fabrication.

E. For limitations of loads to metal decking see Section 01840.

F. All deck units shall have male and female interlocking side joints.

G. All deck units with concrete or insulating concrete shall be vented to provide 1% open area.

H. Prior to covering or filling with insulation, roofing, or placing concrete over metal decking, verify and coordinate installation requirements of suspended metal framing, suspended acoustical ceiling systems, mechanical and electrical work or other items as required. Provide inserts, clips, anchors or fasteners as indicated or as otherwise required to provide for the complete and proper installation of suspended items from the metal deck.
   1. Verify and coordinate locations, patterns, spacing, etc. of suspension members and connectors required by other Sections of the Specifications and as shown on drawings.
   2. Where suspension or hanger wires are required under other Sections, verify and coordinate locations, patterns, spacings, etc. with the appropriate trade. Drill holes at bottom of deck flutes of sufficient size to pass support wires. Wire supports shall be looped and secured with a minimum of three (3) tight turns around a minimum 1-1/2" x 8" long furring channel or No. 3 x 12" long reinforcing bar centered above the hole and laid in the deck flutes. Pig-tail loops into the concrete will not be permitted unless approved by the General Contractor. Place no wires in flute with side lap.
   3. At unfilled metal deck or as otherwise indicated, required or shown, provide individual 18 gauge by 1-1/2" wide galvanized hanger tabs 6" long and having 2" round holes for attaching tie wires. Tabs shall be hooked over male portion of each edge joint at 16" on center before female joint of next sheet is placed over it. As an alternate, #3x12" long reinforcing bars centered above the hole and laid in the deck flutes may be used. No loading other than suspended ceilings may be suspended from metal deck without concrete fill. Suspend all piping, ducting, conduit and equipment from steel beams.

I. Structural Properties: Deck shall have minimum structural properties as indicated on Structural Drawings.

J. Accessories to be furnished shall include the following:
   1. Cell closures where shown on Drawings.
   2. Light gauge plate fillers attached to deck to provide an uninterrupted roof plane.
   3. Drain sumps and/or roof drain mounting plates as detailed.
   4. Cell end closures column flashing and miscellaneous closures to prevent concrete leakage.
   5. Miscellaneous accessories incidental to erection of deck.

K. At concrete filled metal deck floors:
   1. The final top of concrete elevation shall not deviate by more than 3/8” above or below the top of concrete elevation noted on plan.
   2. Floor flatness for concrete over metal deck shall conform to ACI 117. Unless stricter requirements are specified by the Architect, floor flatness for the completed overall floor area shall meet the following minimum values:
      Specified Overall Value for Flatness (SOF_F): 25
      Minimum local value for flatness (mlf_f): 17

Areas of non-compliance shall be reviewed by the owner and architect and may require additional floor leveling or grinding. The cost of any remedial action shall be borne by the contractor.

3. In no case shall the depth of concrete over metal deck be less than that specified on plan. Note that the concrete depth will vary due to deck and beam deflections during concrete placement, and shall be considered in the estimating of concrete volume, cost and placement strategies.

L. At concrete filled metal deck roofs:

1. Concrete over metal deck at roofs shall be placed to maintain the design thickness specified on plan at all locations within the roof area.

2.2 MATERIALS

A. Provide deck of type and gage shown on the drawings. Deck units and all necessary items shall be formed from steel sheets conforming to ASTM-A653, structural quality. The steel sheets shall have received, before being formed, a metal protective coating of zinc conforming to ASTM-A653 Class G60 coating.

B. Powder Actuated Fasteners (shotpins): Where decking is attached with shotpins, they shall be by Hilti Inc., of the type indicated on the drawings and ICC-ES approved for use in a diaphragm.

C. Welding rods: E60XX minimum.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas to receive work specified. Do not begin work until underlying work is complete, all required inspections have been made, and all conditions which might prevent proper installation or impair performance of work have been corrected.

B. Beginning installation means accepting conditions of underlying work.

C. If supporting steel work is not properly aligned or sufficiently level to permit proper bearing of metal decking, such deficiency shall be corrected by the Contractor before placing units.

3.2 ERECTION

A. Deck shall be laid true to line, shall conform to profile shown on Drawings, and shall be without deformations, creases, wrinkles or noticeable defects.

B. Connections: Deck shall be secured to structural frame by use of 3/4" diameter fusion welds. Minimum number and spacing of connections shall be as indicated on Structural Drawings.

C. The metal deck shall be fastened to all structural members both parallel and perpendicular. Spread deck and modify layout where structural members are parallel to the metal deck ribs.

D. Bend decking to conform to slopes and warps as required for solid contact to framing that allows proper welding.

E. Shoring for metal decking shall be provided by the contractor as required and as indicated in the corresponding ICC-ES report. Coordinate shoring requirements for construction live load (and concrete placement) with the manufacturer.

F. All deck units shall break over beams.

G. Provide low ribs at all beams parallel to deck. As an alternate, the deck may be broken and infilled with a flat pan to provide deck welding to parallel beams.

H. Butt deck units tight over steel beams.

I. Provide ¾" clear concrete cover around all welded studs.

3.3 DEFECTIVE DECK

A. Units of decking that become deformed or damaged to such extent that they are weakened or unsuitable for use shall be removed and replaced at no cost to the Owner.

3.4 TOUCH UP AND CLEANING

A. All welds and abrasions on deck surfaces not covered by concrete shall be touched up using a zinc dust-zinc oxide primer.

B. Burn spots on supporting exposed steel shall be touched up with same primer as used on adjacent surface.

C. Clean surfaces of installed deck by effective means to receive sprayed-on fireproofing or finish painting as indicated.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Requirements of Division 1 apply to all Work of this Section.

1.2 SCOPE

A. All items of miscellaneous metal and related accessories and fasteners, including but not necessarily limited to the following:
   1. Steel pipe railing, handrails, guardrails and brackets.
   2. Backing and mounting plates for equipment items.
   3. Ceiling support system.
   4. Anchor bolts.
   5. Auxiliary angles brackets.

1.3 QUALITY ASSURANCE

A. Standards and References: (Latest Edition unless otherwise noted)
   1. 2022 California Building Code (CBC)
   2. American Society for Testing and Materials (ASTM).
   3. Federal Specifications (FS).
   4. American Institute of Steel Construction's "Specification for Structural Steel Building".
   5. American Welding Society's "Structural Welding Code" (AWS D1.1).
   6. American Iron and Steel Institute's "Specifications for Design of Light Gauge Cold-Formed Stainless Steel Structural Members".
   7. National Association of Architectural Metal Manufacturer's: "Metal Stairs" (NAAMM-MS).
   8. Steel Structures Painting Council's "Painting Manual":
      a. Solvent Cleaning (SSPCC-SP 1, latest edition).
      b. Hand Tool Cleaning (SSPC-SP 2, latest edition).
      c. Brush-Off Blast Cleaning (SSPC-SP 7, latest edition).
   9. American Hot Dip Galvanizers Association, Inc. (AHDGA):
      a. Inspection manual for hot dip galvanized products.

B. Welded Qualifications: Welders shall be qualified in accordance with AWS D1.1. (latest edition)

C. Design Criteria:
   1. Work shall be designed to support normally imposed loads and conform to AISC requirements.
   2. Built-up parts shall not exhibit warp.

D. SUBMITTALS
   1. Submit under provisions of Section 01 33 00.
   2. Manufacturer's literature describing products including details and dimensions.

3. Shop Drawings:
   a. Show a large scale construction of various parts, methods of joining, thickness of metals, profiles of surfaces, reinforcing, anchorage, and structural supports. Include information regarding concealed and exposed joints, welds, and fastenings.
   b. Where welded connectors and concrete inserts are required to receive Work, show size and locations required.
4. Samples: Only as requested by the Architect

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle packaged materials in original containers with seals unbroken and labels intact until time of use.

B. Discharge materials carefully and store on clean concrete surface or raised platform in safe, dry area.

1.5 JOB CONDITIONS

A. Scheduling, Sequencing:
   1. Ensure timely fabrication of items to be embedded or enclosed by other Work.
   2. Furnish information and assistance required for locating embedded items and be responsible for proper locations.

PART 2 – PRODUCTS

2.1 BASIC MATERIALS AND ACCESSORIES

A. Ferrous Metals:
   1. Structural Steel Shapes: ASTM A36, conforming to AISC specifications.
   2. Steel Sheets: ASTM A568, Grade 36.
   3. Steel Pipe: ASTM A53.
   4. Steel Bars: ASTM A36.
   5. Steel Tubing: ASTM A500, Grade C.
   6. Steel Plate: ASTM A36.
   7. Checker Plate: flat back carbon steel, pattern 15 or 16 (architect to verify).
   8. Zinc for Galvanizing: ASTM B06 as specified in ASTM A123.
   9. Welding Electrodes: E-70XX.
   10. Grout: Masterflow 928 Grout by Master Builders or approved equal.

B. Fastenings:
   1. Typical Unfinished Bolts, Nuts, and Washers: Low carbon steel standard fasteners, externally and internally threaded, ASTM A307 Grade A; malleable washers.
   2. Expansion Bolts: Hilti's "Kwik-Bolt TZ2 Anchors" or approved equal.

C. Primer: Zinc-chromate type. Same as manufactured by Fuller-O'Brien Corp.'s Ne. 121-00; The Glidden Co.'s No. 4570; Sinclair Paint Co.'s 20; or approved equal (architect to verify).

2.2 SPECIALTY FABRICATED PRODUCTS

A. Preparation:

1. Coordinate with other Work supporting or adjoining miscellaneous metal and verify requirements of cutting out, fitting, and attaching.
2. Verify sizes, designs, and locations of items; do so at site whenever construction progress permits.

B. General Requirements:
1. Fabricate items from materials noted and make true to profiles shown. Obtain the Architect's approval of proposed variations.
2. Miter corners and angles of frames and moldings unless otherwise noted.
3. Perform cutting, shearing, drilling, punching, threading, tapping as required for items or their adjacent Work.
4. Drill or punch holes; do not use cutting torch.
5. Ensure shearing and punching leaves true lines and surfaces.
6. Items to be Galvanized: Fabricate in accordance with recommended practices of ASTM A385 unless specifically noted otherwise.
7. Fabricate exterior items for assembly and installation on site without field-welding of joint.
8. Ensure metal thickness and assembly details provide ample strength and stiffness.
9. Size sleeves for approximately 1/4" clearance all around.

C. Fastening:
1. Provide fasteners and anchor assemblies required for complete fabrication, field assembly, and erection.
2. Conceal fastenings wherever practicable.
3. Size internally threaded diameters to accommodate galvanized threaded bolts where galvanizing is required.
4. Permanent Connections in Ferrous Metal Items: Employ welding wherever practicable; avoid bolts and screws.

D. Welding:
1. Use electric shielded-arc process according to AWS D1.1.
2. Maintain shape and profile of item welded.
3. Prevent heat blisters, run-throughs, and surface distortions.
4. Welds Normally Exposed to View in Finished Work: Make uniform and grind smooth.
5. Exposed Welds: Remove burrs, flux, welding oxide, air spots and discoloration; grind smooth, polish, or otherwise finish to match material welded.

E. Bolted and Screwed Connections:
1. Use bolts for field connections only, and then only as noted. Countersink heads; finish smooth and flush:
   a. Provide washers under heads and nuts bearing on wood.
   b. Draw nuts tight and prevent loosening of permanent connections by nicking threads.
   c. Use beveled washers where bearing is on sloped surfaces.
2. Where necessary to use screws for permanent connections in ferrous metal, use flat head type, countersink, fill screw slots, and finish smooth and flush.
3. Evenly space exposed heads.

F. Ferrous Metal Pipe Railings:
1. Fabricate in largest sections practicable.

2. Weld shop joints; fit field joints with concealed pins and sleeves.
3. Flush fittings may be used for crosses and tees.
4. Return rails to wall as noted.
5. Close ends with welded cap and ease edges.

G. Handrail Bracket for Pipe Railings: Fabricate according to details on Drawings.

2.3 FINISHES

A. Preparations of Surfaces:
1. Thoroughly clean mill scale, rust, dirt, grease, and other foreign matter from ferrous metal prior to galvanizing, hot phosphate treatment or painting.
2. Where hand cleaning methods are not adequate, clean in accordance with SSPC-SP 1, SSPC-SP 2, or SSPC-SP 7 as required.
3. Completely eliminate burrs, rough spots and pitting from normally exposed ferrous metal items.

B. Galvanizing:
1. Galvanize items after fabrication in largest sections practicable unless otherwise permitted or recommended by ASTM A384 and A385.
2. Where galvanizing is removed by welding or other assembly procedures, touch up abraded areas with molten zinc or zinc-rich paint.
3. Where ferrous metal item is noted to be galvanized, perform galvanizing in accordance with following standards as applicable to item:
a. Hardware items Including Fasteners: ASTM A153.
b. Items Both under 1/8" Thickness and Fabricated from Rolled, Pressed, and Forged Shapes, Plates, Bars, and Strips.
c. Other Fabricated items: ASTM A123.

C. Finish Schedule: Unless noted otherwise in Materials or Standard Catalog Products Articles:
1. Ferrous Metal, Interior Items:
a. Concealed: Clean, chemically etch, and shop-apply one prime-coat.
b. Exposed: Clean, treat with hot phosphate, chemically etch, and shop-apply one prime-coat.
2. Ferrous Metal, Exterior Items:
a. Concealed: Clean and hot-dip galvanize in accordance with galvanizing standards.
b. Exposed: Clean, then hot-dip galvanize in accordance with galvanizing standards, chemically etch, and shop-apply one prime-coat.
3. Special Ferrous Metal Items as Noted Below: Clean and hot-dip galvanize in accordance with galvanizing standards. Do not prime coat:
a. Miscellaneous metal items such as stairs and railings.
4. Items Noted as Chrome-Plated: Same as US26D finish.
5. Hardware Including Fasteners (Bolts, Nuts, Washers, Etc.):
a. Finish to match items fastened.
b. Where galvanizing is required, hot-dip galvanize according to ASTM A153.

2.4 SOURCE QUALITY CONTROL

A. Tests and Inspections: The Owner will employ testing laboratory to test welds per CBC, Section 2213.2.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas to receive Work and verify that setting conditions and dimensions are correct to receive items.

B. Do not start installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install Work plumb, true, rigid, and neatly trimmed out.

B. Do not tighten fastener through finish alone without spacer washers.

C. Provide concrete inserts or predrilled expansion bolts in fastening items into concrete.

D. Protect dissimilar metals from contact with each other or with other materials causing corrosion.

E. Fasten Work tightly to prevent rattle or vibration except where expansion-contraction tolerances are required.

F. Use nonshrink grout mixed in accordance with manufacturer's direction for setting frames, plates, sills, bolts and similar items.

G. Set items shown or required to be installed in sleeves with quicksetting anchor cement unless otherwise noted.

H. Protect metal from damage to surface, profile and shape.

3.3 CLEANING

A. Remove protective devices only when items will safe from other construction operations or removal is required to permit related Work.

B. Clean prime-coated items as required for finish painting.

END OF SECTION

SECTION 05 70 00

DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior:
      a. Decorative metal associated with architectural woodwork and casework.
   2. Exterior:
      a. Entry bollard.
      b. Canopy Metal Frame
      c. Steel framing supports for decorative metal items, as applicable.
      d. Rain drainage including scuppers, gutters and downspouts.
      e. Shop priming.
      f. Hot-dip galvanizing.
      g. Custom-fabricated connectors and plates.
      h. Miscellaneous exposed steel supports.
      i. Shop-applied finishes.

B. Related Requirements:
   1. Design-Build Procedures*:* Section 01 35 20.
   2. Metal Specialties: Section 05 59 00.
   3. Louvers and Vents: Section 08 91 10.
   4. Painting and Coating: Section 09 90 00; field-applied coatings.
   5. Signage: Section 10 40 00; dimensional building identification characters interfacing with decorative metal.
   6. Electrical: Division 26; light fixtures and electrical work in connection with decorative metal.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
   1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00 “Submittal Procedures.”

B. Coordination:
   1. Coordinate installation of anchorages. Furnish setting drawings, diagrams, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors, to be embedded in concrete.
   2. Exterior Items: Coordinate with other Sections to ensure watertight installation and proper drainage.
   3. Coordinate sequence of installation with Sections whose work adjoins decorative metalwork.

C. Pre-installation Meeting: Prior to installation of selected decorative metal and associated work, Design Builder, Owner Representative, representative of component manufacturer or fabricator, installer, and other installers whose work interfaces with decorative metal work or may affect its quality shall meet at the Project site to coordinate related requirements.
   1. Notify participants at least 5 working days before conducting meeting.

2. Review material selections and procedures to be followed in performing the work.
3. Review in detail job conditions, schedule, construction sequence, installation requirements, and quality of completed installation.
4. Review in detail the means of protecting completed work during remainder of construction period.
5. Record discussions of meeting and any conflict, incompatibility or inadequacy. Furnish a copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Shop Drawings:
1. Large-scale drawings for fabrication and erection of assemblies not completely shown by manufacturer's product data.
a. Include, as appropriate, plans, elevations, complete details, thicknesses, sizes, types, grades, classes of metal, connecting and joining methods, anchorages.
b. Show required field measurements and interface with work of other Sections.
c. Welds, both shop and field, shall be indicated by AWS "Symbols for Welding, Brazing and Nondestructive Examination," A2.4.
d. Indicate all required field measurements.
2. Setting drawings, templates, instructions, and directions for installation of anchorage devices.
3. Coordinate with shop drawing requirements of other Sections whose work adjoins decorative metalwork.
4. Provide shop drawings for specified mockups.

B. Product Data: Manufacturer's specifications for manufactured products including shop-applied coatings.

C. Samples:
1. Exposed metals in selected finishes, 12 inches x 6 inches, or 12 inches long as applicable.
2. For products involving selection of color, texture, or design including mechanical finishes.
3. Additional samples as requested by the Owner Representative.

D. Sustainable Design:
1. Compliance with the California Green Building Standards Code (CALGreen) goals for this Project.

1.4 INFORMATIONAL SUBMITTALS

A. Certification for each welder.

B. Statement of qualifications for fabricators, installers, and welders.

C. Galvanizing: Proposed methods of cleaning and profiling surfaces. Include methods for each decorative item.

1.5 QUALITY ASSURANCE

A. Qualifications: Design engineer shall be a structural or civil engineer registered in the State of California.

B. Welding procedures and operations shall comply with AWS B2.1, "Standard for Welding Procedure and Performance Qualifications." Comply with AWS publication "Welding Zinc Coated Steel" for galvanized products.

C. Mockups:
1. Each mockup shall consist of a typical assembly in specified finish, complete with mounting devices, and shall be sufficiently large and complete to demonstrate installation and aesthetic effect of completed assembly.
2. Install mockups as approved by Owner Representative.
3. If requested, make modifications to mockups without additional charge to the Owner.
4. Do not proceed with remainder of installation until mockups have been approved.
5. Where appropriate and acceptable to Owner Representative, approved mockups may become part of the completed Work.
6. Comply with additional requirements of Section 01 43 39 “Mockup Requirements.”

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements specified in Section 01 60 00 "Product Requirements."

1.7 FIELD CONDITIONS

A. Field Measurements: Where decorative metal is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on shop drawings.
1. Allow for trimming and fitting wherever taking of field measurements before fabrication might delay work.
2. Coordinate fabrication schedule with construction progress so as to avoid construction delays.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions, and proceed with fabricating decorative metal without field measurements. Coordinate with other construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Industry Standards:
1. Comply with NAAMM MBG 531, "Metal Bar Grating Manual."

B. Regulatory Requirements:
1. Comply with the Americans with Disabilities Act (ADA).
2. Comply with the CBC.

C. Exposed steel of decorative metal items shall be considered Architecturally Exposed Steel and conform to the Category AESS 3, unless otherwise approved during mockup review, for Architecturally Exposed Structural Steel as included in ANSI/AISC 303-16 “Code of Standard Practice for Steel Buildings and Bridges,” and the additional recommended practices of the Architectural Products Division (AMP) of the National Association of Architectural Metal Manufacturers (NAAMM)..

D. Sheet metal work shall comply with applicable provisions of the "Architectural Sheet Metal Manual (SMACNA Manual)," as issued by the Sheet Metal and Air Conditioning Contractors' National Association Inc. (SMACNA).

E. If modifications to designs indicated on the Drawings are proposed in order to meet code requirements, indicate them as such on shop drawing submittals. Work with Owner Representative to arrive at an acceptable design that is sufficiently similar to the design indicated.

2.2 METAL MATERIALS

A. General: Metal surfaces exposed to view shall not exhibit pitting, seam marks, roller marks, splice marks, mill identification markings, stains, discolorations, or other blemishes and imperfections.

B. Steel: Provide steel and iron, in form indicated, to comply with the following requirements:
1. Plate, Shapes, and Bars: ASTM A36.
2. Sheet: Commercial-quality, cold-rolled, stretcher-leveled, carbon-steel sheet complying with ASTM A1008, Class I, matte finish.

C. Bronze:
1. Extrusions: ASTM B455, Copper Development Association (CDA) Alloy 385 (Architectural Bronze).
2. Solid Fittings: Color matching casting alloy; CDA Alloy 865 meeting ASTM B584 for sand castings.
3. Sheet and Plate: As selected by fabricator; alloys suitable for fabrication and use of each item and for finish selected by Architect.
4. Finish: Oil rubbed.

2.3 ADDITIONAL MATERIALS

A. Resilient Pads: Closed-cell neoprene complying with ASTM C864, in black color.

B. Anchor Bolts: ASTM A307, nonheaded type, unless otherwise indicated.

C. Fasteners: Use fasteners of same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
1. Fasteners for Exterior Steel Items:
a. Use stainless steel for fasteners up to 1/2 inch in diameter, unless otherwise shown.
b. Use hot-dip galvanized fasteners for fasteners over 1/2 inch in diameter, unless otherwise shown.
2. Provide concealed fasteners for interconnecting decorative metal components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method. Exposed fasteners shall be indicated on required submittals.

D. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS specifications, and as required for color match, strength, and compatibility in fabricated items.

E. Nonshrink Grout: As specified in Section 05 59 00 “Metal Specialties.”

2.4 MANUFACUTRED COMPONENTS

A. Canopy Metal Frame: Location indicated on drawings.

2.5 FABRICATED ITEMS

A. Bollards: Steel pipe, concrete filled, with crowned cap as follows as shown.
   1. Fixed: Rounded concrete.
   2. Steel pipe to be shop primed & field painted “safety yellow”.

B. Miscellaneous Framing and Supports:
   1. Provide as required to complete the Work.
   2. Fabricate to sizes, shapes, and profiles shown or required.
      a. Except as otherwise shown, fabricate from structural steel shapes, plates, and steel bars, of all-welded construction, using mitered corners, welded brackets and splice plates, and a minimum number of joints for field connection.
      b. Cut, drill, and tap units to receive items anchored to the Work.
   3. Galvanize miscellaneous framing and supports wherever indicated and used in an exterior location.

2.6 FABRICATION METHODS - GENERAL

A. Form decorative metal to required shapes and sizes, with true lines and angles. Provide components in sizes and profiles indicated.

B. Use special care so as to avoid bending, twisting, or otherwise distorting individual members.

C. Castings shall be sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire-brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

D. Provide rebates, lugs, and brackets as required to assemble units and to attach to other work. Drill and tap for required fasteners, unless otherwise indicated. Use concealed fasteners, unless otherwise indicated on reviewed shop drawings.

E. Joints and Connections:
   1. Shop-assemble items to greatest extent possible so as to minimize field splicing and assembly. Disassemble only as necessary for shipping and handling limitations. Clearly mark items for reassembly and coordinated installation.
   2. Use connections that maintain structural value of joined pieces.
   3. Detail connections to facilitate fabrication and erection in accordance with the referenced AISC code.
   4. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather so as to exclude water penetration.
   5. Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts, lag bolts, and other connectors as required.
   6. Fabricate and space anchoring devices as shown and required to provide adequate support for intended use.

F. Welding and Brazing: Comply with AWS-recommended practices.
   1. Welds shall be continuous.
   2. Weld and braze behind finished surfaces without distorting or discoloring exposed side.

3. Remove flux from exposed welded and brazed joints. Dress exposed and contact surfaces.

G. Finishing:
1. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
2. Welds, burrs, roller marks, seams, and rough surfaces shall be ground neat and smooth.
3. Mill markings shall be completely removed.
4. Gouges, dents, and other surface abuse shall be filled and ground smooth.
5. Stainless Steel: Use electrochemical or mechanical methods or abrasive cleaners to remove weld discoloration on exposed surfaces. Welded area shall match appearance of adjacent surface after cleaning.

2.7 GALVANIZING

A. Hot-dip galvanizing is required for exterior steel.
1. Comply with ASTM A153 for galvanizing of iron and steel hardware.
2. Comply with ASTM A123 for galvanizing of assembled steel products and rolled, pressed, and forged-steel shapes, plates, bars, and strips 1/8 inch thick and heavier.

B. Surface Preparation Prior to Galvanizing: In accordance with SSPC Specification SP-10, "Near White Blast Cleaning."

C. Newly galvanized items shall not be water quenched or chromate quenched after galvanizing if they are scheduled to receive a paint coating.

D. Repair galvanized coating damaged after fabrication during handling, installation, or welding. Use specified repair paint in accordance with ASTM A780, AGA publication, "Recommended Practice for Touch-up of Damaged Galvanized Coatings," and manufacturer's recommendations for application of repair paint.

2.8 PROTECTIVE PAINT COATINGS

A. General:
1. Comply with manufacturer's preparation and application instructions for each coating and NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Manufacturer's instructions shall govern in event of conflict.
2. Coatings shall be shop-applied to the greatest extent possible, including galvanized items, except surfaces and edges to be field welded.
3. Corrosion Control: Prevent galvanic action and other forms of corrosion by insulating metals from direct contact with incompatible materials.
4. Steel members shall be protected and be free of corrosion when ready to receive field-applied finish coatings. Apply coatings before rusting occurs.
5. Metal shall be degreased.
6. Finish exposed fasteners to match adjacent metal.
7. Primers shall be compatible with finish coat.

B. Products:
1. Primers and Finish Paints: As specified under each coating system.
2. Galvanizing-Repair Paint: Minimum 82 percent zinc-dust-content paint for regalvanizing welds in galvanized steel; "Z.R.C. Cold Galvanizing Compound" by ZRC Worldwide, "Cold Galv Primer" by Valspar, or accepted equal.

C. Surface Preparation - General:
   1. All Metals: Removal soluble salts as specified in Section 09 90 00, “Painting and Coating,” prior to other surface preparation.
   2. Non-Galvanized Steel: SSPC-SP No. 6/NCACE No. 3 “Commercial Blast Cleaning.”
   3. Galvanized Steel: As specified.
   4. Comply with any additional procedures required by the coating manufacturer.

D. Surface Preparation - Galvanized Surfaces:
   1. General:
      a. Comply with the procedures included in the AGA Publication “Guide to Preparing Hot-Dip Galvanized Steel for Painting.”
      b. Surfaces shall be cleaned and profiled prior to receiving applied coatings in accordance with ASTM D6386 for paint, ASTM D7803 for powder coatings, or ASTM D7396 for sheet products and in accordance with SSPC Specification SP-16, "Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
      c. Specific methods shall be selected based on age of galvanized coating, condition of surface and intended paint coating.
      d. High spots and rough edges shall be smoothed out.
      e. Care shall be taken not to damage the zinc coating.
      f. Do not use phosphate treatment on galvanized surfaces scheduled to receive zinc-rich primers.
   2. Cleaning: Surface shall be prepared in accordance with SSPC SP-1 with specified cleaner and followed by application of pre-paint conditioner.
   3. Profiling: After cleaning, surfaces shall be profiled by abrasive sweep or brush blasting to smooth surface.
      a. Blast material particle size for profiling galvanized steel should range between 8 to 20 mils (200 to 500 microns).
      b. The blast profile on the galvanized surface should be less than 2.0 mils and more than 1.0 mils.
   4. Comply with the additional recommendations included in the AGA document “Duplex Systems: Painting Over Hot Dip Galvanized Steel,” ASTM D6386, and of coating manufacturer.

E. Coating Systems:
   1. System INT 5.1A-5 - Standard Performance Acrylic on Shop-Primed Metal:
      a. Surface Preparation prior to Priming: As specified.
      b. Shop Primer: Modified alkyd.
      c. Topcoats: As specified in Section 09 90 00 "Painting and Coating."
   2. System INT 5.3H-5 - Premium Performance Finish on Decorative Metal:
      a. Surface Preparation Prior to Priming: As specified.
      b. Primer and Topcoat: As specified in Section 09 90 00, "Painting and Coating."
   3. System EXT 5.3T-5 - High-Performance Fluoropolymer Finish on Galvanized Metal.
      a. Surface Preparation Prior to Priming: As specified.
      b. Intermediate and Topcoat: As specified in Section 09 90 00 "Painting and Coating."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install decorative metalwork as shown on the Drawings in accordance with reviewed submittals and referenced standards.

B. Cut, drill, and fit as required for installation.

C. Set work accurately in location, alignment, and elevation; plumb, level, and true; and free of rack; measured from established lines and levels.

D. Adjust items prior to securing in place so as to ensure proper matching of components and correct alignment.

E. Where glazing channel, including smoke curtain, is recessed into floor or ceiling, install firmly and securely in accordance with reviewed submittals, and to match accepted mockups.

F. Field Welding:
1. Comply with applicable AWS specification for procedures of manual shielded metal arc welding, for appearance and quality of welds and for methods used in correcting welding work.
2. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
3. Grind exposed welded joints smooth, unless otherwise specified, and restore finish to match finish of adjacent surfaces.

G. Erection Tolerances:
1. Variation from Level: Maximum 1/4 inch in any column to column space or 20-foot run, noncumulative.
2. Offsets in End-to-End or Edge-to-Edge Alignment of Consecutive Members: 1/16 inch.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of Division I apply to all Work of this Section.

1.2 SCOPE

A. Provide all labor, materials, tools, facilities and equipment required for the fabrication and installation of rough carpentry and associated items (except that which is specified elsewhere) indicated on Drawings and necessary to complete the Work. Items include, but are not necessarily limited to, the following:
   1. Blocking, backing, stripping, furring, and nailers.
   2. Rough hardware.
   3. Wood framing.
   4. Wood sheathing.
   5. Preservative treatment.
   6. Drilling, saw cuts, knock-outs and framing for ventilation.
   7. Wood sheathing backing at tile walls.

1.3 RELATED WORK (SEE ALSO TABLE OF CONTENTS)

A. Concrete Formwork: Section 03 10 00.

B. Cast-in-Place Concrete: Section 03 30 00.

C. Structural Steel: Section 05 12 00.

1.4 QUALITY ASSURANCE

A. General:
   1. Coordinate the work of all trades to ensure proper placement of all materials, anchors, etc., as well as providing for openings and anchors for the installation of surface mounted materials and equipment.
   2. Qualifications for Workmen: Provide sufficient skilled workmen and supervisors who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of construction involved and the materials and techniques specified.
   3. Rejection: In the acceptance or rejection of rough carpentry, no allowance will be made for lack of skill on the part of the workmen.

B. Standards and References: (Latest Edition unless otherwise noted)
   1. 2022 California Building Code (CBC).
   2. Lumber: West Coast Lumber Inspection Bureau (WCLIB); Standard Grading Rules for West Coast Lumber No. 17.

3. Lumber: Western Wood Products Association (WWPA); Western Lumber Grading Rules 05.
4. Redwood: Redwood Inspection Service (RIS); Standard Specifications for Grades of California Redwood Lumber.
5. Wood Sheathing: The Engineered Wood Association; Specifications and Grades.
   a. Structural Plywood: United States Product Standard PS1, Group 1 Douglas Fir.
   b. APA rated sheathing: United States Product Standard PS2.
6. Wood Preservative: American Wood-Preservers' Association (AWPA):
   a. U1, Use Category System: User Specification for Treated Wood.
   b. M4, Standard for the Care of Preservative-Treated Wood Products.
7. 2018 National Design Specification for Wood Construction (NDS).

C. Submittals: (Submit under provisions of Section 01040)
   1. Certification:
      a. Preservative Treated Wood: Certification for waterborne preservative and that moisture content was reduced to 19 percent maximum, after treatment.

D. Tests and Inspections:
   1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the 2022 CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
   2. If indicated on the Structural Drawings, load test expansion and epoxy anchors as indicated on the drawings.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protection:
   1. After delivery, store all materials off the ground, covered, and in such a manner as to ensure proper ventilation and drainage and to protect against damage and the weather. Maintain wood at the maximum moisture levels indicated in Materials Section.
   2. Keep all material clearly identified with all grade marks legible; keep all damaged material clearly identified as damaged, and separately store to prevent its inadvertent use. Do not allow installation of damaged or otherwise non-complying material.
   3. Use all means necessary to protect the installed work and materials of all other trades.
   4. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sawn Lumber:
   1. Lumber (Wood Framing): Meet requirements grade No.1. All grades to WCLIB Grading Rules No. 17. Species shall be Douglas Fir - Larch
   2. "At initial use" shall be that point at which nails, screws, bolts, split rings, shear plates or other fasteners or the holes for said fasteners are placed in the wood.
   3. All sawn lumber is assumed to be enclosed in the dry building envelope in the final service condition, unless noted otherwise, and free to dry to moisture content less than 19%.

4. The Contractor shall use whatever means necessary, including site drying to ensure that the moisture contents above are not exceeded.
5. All studs, plates, joists, rafters and beams 3x and thicker shall be free of heart center in accordance with the specified grading standards.

B. Wood Sheathing:
1. Roof and Wall Structural Sheathing: PS1 and PS2 APA rated sheathing with exterior glue. Thickness type and grade shall be as indicated on Drawings.
2. Where indicated on the Architectural Drawings as interior wall backing behind tile and in all toilet rooms behind sheet rock, to be C-C APA rated sheathing with exterior glue. Thickness shall be 5/8-inch at all locations.
3. Flooring: C-C APA Performance rated tongue and groove with exterior glue. Thickness type and grade shall be as indicated on the Drawings.

C. Building Paper: Fed. Spec. UU-B-790a, Type I, Grade B (15 lb. min. unless noted elsewhere.).

D. Rough Hardware Fastenings and Connections: All types including bolts, lag screws, nails, spikes, screws, washers and other rough hardware, of kinds that may be purchased and that require no further fabrication, shall be furnished and installed for all finish and rough carpentry and shall conform to 2018 NDS Standards and dimensions. All hardware exposed to weather shall be hot-dipped galvanized per ASTM A153 Standards. All nails used into pressure treated lumber shall be hot-dipped galvanized per ASTM A153 or stainless steel.
1. Common wire nails or spikes unless noted otherwise on the Drawings. Box nails and sinker nails are not permitted. Vinyl coating is permitted on nails when not exposed to weather.
2. Bolts: Bolt material shall conform to ASTM A307, Grade A. Bolt dimensions shall conform to ANSI/ASME B18.2.1 with hex head of sizes indicated.
3. Lag Screws: Lag screws shall conform to ASTM 307, Grade A. All lag screws shall have hex heads where exposed.
4. Washers: Standard flat washers shall conform to ANSI B18.22.1, Type A, Wide Pattern. Steel plate washers shall be Simpson BP or BPS or equivalent. Malleable iron washers shall be standard malleable iron washers.
5. Powder Driven Fasteners: Tempered steel pins with special corrosive resistant plating or coating. Pins shall have guide washers to accurately control penetration. Fastening shall be accomplished by low-velocity piston-driven power activated tool. Pins and tool shall be as manufactured by Hilti Fastening Systems or equivalent. See Drawings for size, type and embedment.
6. Expansion Anchors: See Section 03300 for anchors to concrete and Section 04200 for anchors to masonry.
7. Adhesive Anchors: See Section 03300 for anchors to concrete and Section 04200 for anchors to masonry.
8. Fabricated Metal Timber Framing Connectors: Connectors shall be punched for nailing and bolting. Nails and nailing shall conform to the manufacturer's instructions with a nail provided for each punched hole. All connectors must have specific ICC approval. Types as noted on Drawings are Simpson Strong-Tie. Hardware suppliers other than Simpson shall submit a comparative material list itemizing product designation, load rating and supported member size for review by the enforcement agency and the Structural Engineer.

2.2 FABRICATION

A. Lumber:

1. All lumber shall be air or kiln-dried to the maximum moisture content indicated in Materials Section.
2. Furnish S4S unless otherwise noted.
3. Size to conform to rules of governing standard. Sizes shown are nominal unless otherwise noted.

B. Wood Treatment:
1. Preservative Treatment: The treating process and results thereof shall conform to the appropriate AWPA Standards for exterior, above ground use (3B) and as indicated in CBC Section 2303.1.8.
2. After treatment and prior to shipping, air or kiln-dry lumber to maximum 19 percent moisture content.
3. All treated wood shall be identified with a label meeting the requirements of CBC Section 2303.1.8.1.
4. The amount of preservative to be injected into the wood shall be as required by the AWPA standard for each type of installation.
5. All wood in contact with concrete or masonry shall be preservative treated.
6. Cut surfaces and bored holes in pressure treated wood shall be protected in accordance with AWPA Standard M4.

C. Fire Treatment: All fire-retardant-treated wood shall be identified with a label meeting the requirements of CBC Section 2303.2.1. The treating process and results thereof shall meet the requirements of CBC Section 2303.2 . Moisture content of fire-retardant-treated wood shall meet CBC Section 2303.2.5. Treater shall submit design and fastener valves for treated wood to Structural Engineer for review. See Drawings for location of fire-retardant-treated wood.

2.3 SOURCE QUALITY CONTROL

A. Grade Mark each piece of lumber. Marking must be done by recognized agency.
1. Douglas Fir shall bear WCLIB or WWPA grade stamp.
2. Pressure treated Douglas Fir shall bear AWPA Quality mark.

B. Wood Sheathing: Each panel shall be legibly identified as to type, grade and specie by APA grade. If plies are spliced, the slope of the scarf shall not be steeper than 1:8. White pockets will not be permitted in face plies.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:
1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly proceed.
2. Verify that rough carpentry may be performed in strict accordance with the original design and all pertinent codes and regulations.

B. Discrepancies: In the event of discrepancy, immediately notify Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 WORKMANSHIP

A. General: All rough carpentry shall produce joints true, tight, and well nailed with all members assembled in accordance with the Drawings and with all pertinent codes and regulations.

B. Selection of Lumber Pieces: Carefully select all members. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making proper connections. Cut out and discard all defects which will render a piece unable to serve its intended function.

C. Lumber may be rejected by the Architect, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.

D. Shimming: do not shim any framing component.

E. Care shall be taken that notching and boring of members is in strict conformance with the Drawings and that there are no over-cuts.

3.3 FASTENING

A. Nailing: Except as otherwise indicated on Drawings or specified, all nailing shall be as required by CBC Table 2304.9.1 - Fastening Schedule.
   1. Nails or Spikes shall be common wire unless noted otherwise. Penetration of nails or spikes shall be one-half the length of the nail or spike into the piece receiving the point. However, to connect pieces 2" in thickness, 16d nails shall be used unless noted otherwise.
      a. Bore holes for nails wherever necessary to prevent splitting.
      b. Use finish or casing for finish work.
      c. Use of machine nailing is subject to a satisfactory installation of nails. Minimum edge distances shall be maintained. Nails installed through sheathing with nail guns shall not penetrate into the outer plies deeper than hand nailing. Submittal of guns and nails is required.
      d. All nailing into Pressure-Treated lumber shall utilize hot-dipped zinc coated galvanized nails or stainless steel nails per CBC Section 2304.9.5.

B. Bolts and Lag Screws: Bolts shall be sizes indicated on Drawings. Holes for bolts shall be 1/16-inch larger than the bolt diameter. Malleable, Steel plate or standard flat washers shall be used where heads or nuts would otherwise bear directly on wood surfaces. Malleable or plate washers shall be used on all anchor bolts. Cut washers are not permitted. Lag screws shall be screwed (not driven) into place. For the shank, holes shall be bored the same depth and diameter as shank. For threaded portion, holes shall be pre-drilled as follows:

Lag screw size	Thread portion pre-drill
1/2” diameter	1/4” diameter
5/8” diameter	5/16” diameter
3/4 diameter	3/8” diameter
7/8” diameter	1/2” diameter
1” diameter	5/8” diameter

Soap lag screws prior to installation. Tighten all bolts and screws before closing in.

C. Framing Devices: Install according to the manufacturer’s instructions unless otherwise noted.

3.4 FRAMING AND ROUGH CARPENTRY

A. Sills: Shall be in long lengths of sizes shown, fastened with anchor bolts as indicated, a minimum of two anchor bolts per piece. Place steel plate washers (but not standard flat or malleable iron washers) under nuts bearing on wood. Set sills level and true.

B. Studs, Posts and Columns: Shall be full length. Corners shall be as detailed. Partitions or walls containing plumbing, heating or other piping shall be so formed as to give proper clearance for materials. Cut members as required to provide full bearing at ends. Connect to structure as indicated.

C. Plates: Shall be full length of wall segment or 12-foot minimum and spliced as shown.

D. Blocking: Blocking shall be same thickness and width of studs or joists unless shown otherwise. Blocking shall not be spaced over 8'-0" c.c. Install fire blocking in accordance with CBC. Horizontal fire blocking in walls shall be placed at floor lines and ceiling lines unless noted otherwise. Install blocking at all plywood joints where noted on the Drawings. Install wall width full height solid blocking at floor joists beneath all posts in walls. Blocking shall be installed around all wall, floor and roof penetrations.

E. Joists and Beams: Shall be full span length and spliced over bearings unless shown otherwise. Install with crown side up. Beams or headers indicated to be built up of two or more joists shall be fabricated on the job using full length members. For two piece 2x members, stitch nail pieces together with 16d common nails spaced not over 12 inches c.c. and staggered. Clinch nails protruding through members. For three or more piece members, stitch bolt pieces together with ½" bolts spaced not over 12 inches c.c. and staggered.
   1. Provide double joists and headers at all openings through roof unless otherwise shown on Drawings.
   2. Provide typical headers at all openings through walls where one or more studs are required to be cut. For penetration through walls narrower than stud spacing, provide solid blocking on all sides for fastening finish materials.

F. Wood Sheathing: Install to pattern indicated and provide blocking at joints where noted on the Drawings. Center all joints over bearing supports. Nail to framing as indicated. Install wood sheathing with face plies perpendicular to joists or studs unless indicated otherwise. Wall wood sheathing shall continue uninterrupted by ceilings or soffit from floor to floor or floor to roof unless specifically detailed on the Structural Drawings.

G. Wood Furring, Stripping: Install as shown or required to provide nailing materials or passage of pipes, conduits, etc., not otherwise accommodated including ceiling stripping for gypsum drywall construction.

H. Bridging: Space not over 8'-0" c.c. for spans over 16'-0". Joists 8 inches or less in depth shall not require bridging unless specifically indicated.

I. Solid Wood Backing: Solid wood backing shall be provided for all wall and ceiling finishes and for supporting of mounted items for all trades, including but not limited to metal toilet partitions, toilet room accessories, frames, cabinets, casework, mirrors, trim, applied wall finishes, athletic equipment, food service equipment, piping, conduit, ducts, etc. Contractor shall coordinate placement of backing and supports with Subcontractor supplying mounted items.

J. Building Paper: Install in all locations indicated except where included in other sections of the specifications.

K. Cant Strips and Crickets: Shape to sizes shown. Rigidly fasten to construction. Form neat mitered corners.

L. Wood Sheathing Backing: All toilet rooms, restrooms, single or joint occupancy shall have all walls backed with 5/8-inch thick wood sheathing with no surface voids. Install sheathing between the framing members and wallboard. The same wood sheathing shall also be provided and installed at all tile locations. At tile locations wood sheathing shall be installed between the framing members and the resin-cement backing board.

3.5 MISCELLANEOUS CARPENTRY WORK

A. Install all items under other sections specified to be furnished and installed in other sections which relate to the rough carpentry work.

B. Miscellaneous Carpentry Work not included under other sections but, indicated or required yet not specified elsewhere shall be furnished and installed hereunder, including appropriate fastening devices. Contractor shall provide miscellaneous carpentry work for all sections and divisions of work identified.

C. Wood Curbs for Equipment: Construct all wood curbs for roof mounted equipment as detailed. Provide all miscellaneous blocking, bracing, supports, and other wood items as shown or required to complete the work.

D. Plywood Backing for Electrical, telephone, and similar types of wall mounted equipment shall be provided hereunder where required. Plywood shall be 3/4-inch thick exterior A-C plywood with 'A' face exposed.

E. Fire/Draft Stops: Construct fire and drafts stops in furred attic spaces where indicated or required by CBC code. Unless otherwise indicated on Drawings construct of not less than 5/8-inch Type 'X' gypsum wallboard or ½" wood sheathing, adequately supported by 2x4's at 24

inches c.c., braced diagonally to the roof structure. Draft stop and installation work shall conform to code requirements.

F. Shoring and Bracing: Shore or brace for temporary support of all work as required during the construction period except any shoring and bracing specified and included under other sections of these specifications.

G. Temporary Enclosures: Provide and maintain all barricades and enclosures required to protect the work in progress.

H. Protect all work in progress and all work installed, as well as the work of all other trades. Any work damaged as a result of the work under this section shall be corrected to its original condition or replaced if directed by the Architect at no increase in cost to the Owner.

I. Ventilation: Contractor shall include all labor and materials necessary to provide ventilation requirements of roof overhangs, eaves, attics, and all other components of the building required by codes to be ventilated. Work shall include removing knock-outs in wood I-joists for cross ventilation, drilling of blocking, wood sheathing, and other wooden components of the structure necessary to comply with requirements of the CBC for ventilation of buildings.

END OF SECTION

SECTION 06 41 00

ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.
3. Finish hardware for casework.
4. Electric conduit and junction boxes concealed within casework.
5. Preparation of casework for utilities.

B. Related Requirements:
1. Interior Architectural Woodwork: Section 06 40 23; millwork not covered under this Section.
2. Wood Doors: Section 08 1400.
3. Solid Surfacing Countertops: Section 12 36 61.
4. Electrical: Division 26; connection of casework power lines to building service, including any adapters for electrical work at Project site; lamps for lighting fixtures.

1.2 REFERENCES

A. Woodwork Institute (WI): “North American Architectural Woodwork Standards” (NAAWS) published jointly by WI and the Architectural Woodwork Manufacturers of Canada (AWMAC).

B. National Electrical Manufacturers Association (NEMA): NEMA LD3.1: "High-Pressure Decorative Laminates."

1.3 DEFINITIONS

A. Unless otherwise specified, exposed, semi-exposed, and concealed surfaces shall conform to the cabinet surface terminology in Section 10 - Casework of the referenced NAAWS publication.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00 “Submittal Procedures.”
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00 “Closeout Procedures” and Section 01 78 36 “Warranties.”

1.5 ACTION SUBMITTALS

A. Shop Drawings:
1. Submit dimensioned plans, elevations, component profiles, and details for each casework layout showing the following:

a. Locations and type of service fixtures with lines thereto; anchorage locations, installation details to floors and walls.
b. Relationship of units in to surrounding and adjacent construction including walls, doors, and windows.
c. Swing of doors.
d. Shelving.
e. Accessory items such as fillers, end panels, and valance.
f. Base height.

2. Prepare in accordance with NAAWS, Section 1, “Submittals.”
3. First page of shop drawings and each elevation shall bear the WI Certification label.

B. Product Data:
1. Manufacturer’s published product literature for the following.
a. Cabinet hardware items.
b. Laminates.
c. Panel products.
d. Shop-applied coatings.
2. Include manufacturer's literature for items which are proposed for use and specified herein only by listing the intended performance requirements.

C. Samples:
1. Plastic Laminate: 8 inches by 10 inches, for each type, pattern, color, and finish.
2. Solid Stock, if Applicable: 16-inch long with stepped finish.
3. Thermoset decorative panels in specified color.
4. Hardware: Items as requested by the Own’s Representative and/or the Design Builder.

1.6 INFORMATIONAL SUBMITTALS

A. Certification: Before delivery of casework to jobsite, submit WI Certified Compliance Program certificates.

B. Fabricator qualifications.

C. Sample copy of manufacturer's warranties stating obligations, remedies, limitations, and exclusions of warranty.

1.7 QUALITY ASSURANCE

A. Standard for Materials and Workmanship: Comply with applicable requirements of the NAAWS (referred to as the "woodworking standard").

B. Fabricator Qualifications: Firm specializing in quality architectural cabinetwork and active member of WI or AWI. Fabricators not active members of WI or AWI will be considered upon submission of verifiable evidence of experience in successful completion of work similar to work of this Project. This provision does not waive compliance with specified WI Certification.

C. WI Certified Compliance Program:
1. Casework and the installation thereof for this Project shall be certified by fabricator for compliance to the Contract Documents:
a. WI licensees shall issue a Certified Compliance Certificate indicating the casework products being furnished and certifying that these products and their installation will fully meet all the requirement of the WI Grade specified. Certificate shall be submitted prior to delivery of casework to the jobsite.

b. Non-licensees of the WI shall arrange to have a WI Inspector inspect the casework after completion of fabrication and installation and furnish a Certified Compliance Certificate. Contractor shall be responsible for all costs associated with corrections to fabricated or installed work as required to secure the WI Certified Compliance Certificate.

2. Fees charged by WI to either WI licensee or non-licensee are the responsibility of the Contractor.
3. Casework and/or installation determined to be non-compliant by WI and not corrected will be rejected.
4. Issuance of the WI Certified Compliance Certificate is a prerequisite of the Own's final acceptance.

D. Mockup:
1. Build mockup of base cabinet that includes a cabinet door, drawer front, and frame to verify finish material selections, modifications made under sample submittals, and to demonstrate aesthetic effects and set quality standards for materials and execution for cabinet exteriors, interior construction, and hardware.
2. A mockup shall be prepared for each required finish.
3. Comply with additional requirements of Section 01 43 39 "Mockup Requirements."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver products until ambient conditions required can be and are maintained at site storage areas.

B. Do not deliver casework until wet work, painting, grinding, and similar operations in storage and installation areas which could damage, soil, or deteriorate casework have been completed.

C. Protect casework during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.

D. Comply with the additional requirements specified in Section 01 60 00 "Product Requirements."

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until wet work is complete and HVAC system is operating and capable of maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period in areas where casework is to be stored and installed.

B. Obtain field measurements and verify dimensions are as indicated on shop drawings before fabricating casework.

1.10 WARRANTY

A. Manufacturer: In addition to the Contractor's Standard Guarantee, furnish Owner with manufacturer's fully executed written 5-year warranty for casework against defects in materials and workmanship. Warranty shall include against delaminations, joint separations, warp or twist in doors more than 1/4 inch, and splits or cracks in finished surfaces.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Standard for Materials and Workmanship: Comply with applicable requirements of the “North American Architectural Woodwork Standards” (NAAWS) published jointly by WI and the Architectural Woodwork Manufacturers of Canada (AWMAC) and referred to as the "woodworking standard." Where Contract Documents Show requirements that conflict with or augment the woodworking standard, comply with the most stringent requirements.

2.2 WOOD MATERIALS

A. Solid Stock:
1. Concealed: Species and grade as specified in woodworking standard for casework construction, unless otherwise indicated.
2. Moisture content at time of fabrication: As specified in woodworking standard.

2.3 PANEL MATERIALS

A. Hardwood Veneer Plywood: Non-toxic, urea formaldehyde free, hardwood plywood using soy-based adhesive; “PureBond” by Columbia Forest Products, Inc., “Freshply” by True North, or equal.

B. Softwood Plywood: Comply with DOC PS 1 of Types, grades, and cores in accordance with the woodworking standard.

C. Thermally-Fused Melamine Panels (TFM): Melamine resin-impregnated decorative paper thermally fused to a formaldehyde free particle board or MDF core.
1. Colors: As indicated in Finish Legend list, unless otherwise selected by the Owner’s Representative.

D. Hardboard: Tempered Grade, conforming to standards of American Hardboard Association or PS-50; use smooth side exposed.

E. Particle Board: Not permitted.

2.4 LAMINATE MATERIALS

A. High-Pressure Plastic Laminate: Conforming to NEMA LD3.1 and ISO 4586 Parts 1 and 2.

B. Grades:
1. Horizontal Surfaces, Exposed Exterior Vertical Surfaces, and Exposed Interior Vertical Surfaces: 50/HGF; fire-rated performance grade.
2. Semi-Exposed Interior Vertical Surfaces: ISO 32/VGF; fire-rated performance grade.
3. Backing Sheets:
a. Horizontal Surfaces: 89/BGF, fire-rated backing.
b. Vertical Surfaces: 87/BLF, fire-rated backing.

C. Manufacturers, Colors, and Patterns:
1. (CW-2) Plastic Laminate; “Verde Comodora” by Fenix Surfaces, or equal.

2.5 HARDWARE

A. General: Comply with requirements of BHMA A156.9, Type 2 (Institutional).

B. Finishes:
1. Exposed Items at Each Location: To be finalized by Owner's Representative.
2. Concealed Items: Manufacturer's standard finish, complying with applicable product class of ANSI/BHMA A156.9.

C. Hinges: Totally concealed, self-closing: silent and controlled closing, 170 degree opening; Blum "CLIP top" with "Blumotion," or equal. Provide two per door up to 36 inches high, three per door over 36 inches high.

D. Drawer Slides:
1. General:
a. Manufacturer: Accuride as specified, Knape & Vogt, or equal.
b. In addition to capacity, slides shall be sized in accordance with manufacturer's recommendations for drawer width.
c. Type: Side mounted, lift out, full extension.
2. Drawers to 24-inches Wide: Light duty; Model 3732.
a. Load Rating per Pair: 100-pounds.
3. Drawers 24-inches to 36-inches Wide: Medium duty with 1-inch over travel; Model 3301.
a. Load Rating per Pair: 150-pounds.
4. Drawers 36-inches to 42-inches Wide: Heavy-duty with 1-inch over travel; Model 3634.
a. Load Rating per Pair: 200-pounds.
5. Drawers 42-inches to 48-inches Wide: Heavy duty with 1-inch over travel; Model SS5321.
a. Load Rating per Pair: 350-pounds.

E. Door and Drawer Pulls: BHMA A156.9, B02011; Sugatsune DIH Series as specified and the basis of design, or equal.
1. Style: Back-mounted.
2. Lengths:
a. Typical at Drawers and Upper or Lower Cabinets Doors: Nominal 5 inches; DIH-128.
b. Partial Height (3/4) Cabinet Doors: Nominal 14 inches; DIH-342.
c. Full Height Cabinet Doors: Nominal 24 inches; DIH-592.
3. Material: Type 304 stainless steel, satin finish.
4. Unless otherwise indicated, provide one for each door or drawer, two for each drawer 30 inches or wider.
5. Mounting Direction: As shown and noted on the Drawings, unless otherwise noted on reviewed submittals.

F. Shelf Supports:
1. End Supported - Clips:
a. Designed insertion into 5mm holes or 1/4 inch diameter holes
b. Profile to provide for concealed seismic restraint of shelves.
2. Rear Supported Standards and Brackets: Single slot design with 2 inch vertical slot adjustability, BHMA Grade 2 compliant.

G. Locks: Schlage CL2000 Series cabinet and drawer locks with solid brass 6 pin cylinders, or equal.

1. Locations: Provide where shown and requested by the Construction Manager.
2. Cylinders to be keyed into door keying system specified in Section 08 71 00 “Door Hardware.”
   a. All cabinets in each Room to be keyed alike.
   b. All Rooms to be keyed different.

H. Base Levelers, if Used: Adjustable plastic foot and base for screwing into bottom of cabinet.

2.6 ACCESSORIES

A. Bumper Pads (Silencers): Hemispherical, quiet clear type, 55 Shore A hardness; 3M Bumpon Protective Products, or equal.

B. Carcass Adhesive: As recommended by panel manufacturer best suited for the intended use and that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use that has a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Fasteners: Size and type to suit application.

2.7 FABRICATION - GENERAL

A. General: Construction and assembly shall be in accordance with NAAWS requirements for wood casework including casework requirements of Appendix.

B. Grade: NAAWS Custom.

C. Nominal Thicknesses: In accordance with the woodworking standard and as follows.
1. Backs: Panel Product; 3/4 inch, unless otherwise shown.
2. Shelves, Thickness and Maximum Length: In accordance with 40 lb/SF loading.
3. Drawer and Door Fronts: 3/4 inch.

D. Carcass Construction: Type A frameless.
1. Provide as single unit at open shelving.
2. Use specified softwood plywood for plastic laminate backing.

E. Door and Drawer Front Style: Flush overlay, NAAWS Style A.
1. Drawer and door panel edges shall be square.
2. Use specified hardwood veneer plywood as backing for plastic laminate.
3. Backs of doors and drawer fronts shall be finished to match front of door and drawer.

F. Drawers:
1. Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
2. Bottoms: Thermoset decorative panels.

G. Dust Panels: 1/4 inch plywood or tempered hardboard. Locate above compartments and drawers unless located directly under countertop.

H. Holes for Shelf Support Clips: 1-inch or 32mm on center with not less than 3 holes at each shelf location.

1. Locations shall be proposed by Design-Builder, approved by the Construction Manager, and shown on shop drawings.
2. Bottom side of shelf ends shall be routed to receive and conceal clips.

I. Adjustable Shelf Loading and Deflection: In accordance with NAAWS.
1. Capacity: 50 pounds per square foot.
2. Deflection: L/144.

2.8 SHOP FINISHING

A. General:
1. Do not apply finishes until sample submittals are reviewed and approved by the Construction Manager.
2. Prepare surfaces and apply coatings in shop in compliance with NAAWS Premium Grade requirements.

B. Back Painting: Surfaces which are not exposed to view at any time and abut walls or floor shall be thoroughly back painted before leaving the shop.

C. Plastic Laminate:
1. Exposed exterior surfaces and exposed interior surfaces shall be finished with specified high-pressure laminate.
2. Semi-exposed interior surfaces shall be finished with specified high-pressure laminate cabinet liner.
3. Apply plastic laminate finish in full uninterrupted sheet consistent with manufacturer's sizes.
4. Shelving shall be finished with high-pressure laminate.
5. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
6. Do not miter corners of laminated plastic.
7. Shelving, door, and drawer front panels shall be self-edged. Low-pressure laminate, PVC, or other edging materials are not acceptable.
8. Fit corners and joints hairline; secure with concealed fasteners.
9. Securely bond laminated plastic to MDF panel product; do not use plywood.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify concealed backing, reinforcements, and support framing for casework is adequate and in conformance with measurements shown on the shop drawings.

B. Verify utilities and other building items affecting casework are placed and ready to receive work.

3.2 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Complete work not intended for completion in field including backpriming.

3.3 INSTALLATION

A. Install cabinetwork plumb and level and in conformance with requirements of NAAWS Standard and as shown.
   1. Use concealed shims as required.
   2. Accurately scribe and closely fit all faceplates, filler strips, and trim strips to irregularities of adjacent surfaces.
   3. Anchorage shall be acceptable for Project seismic requirements.

B. Fasten cabinets to floor at toe space, unless base levelers are used, and to walls and supporting structure at 24 inches on center maximum.

C. Secure upper cabinets, using wood or metal cleats. Secure cleats with screws penetrating studs or backing plates.

D. Install sealant as specified in Section 07 9200, “Joint Sealants,” as required to close any small unavoidable gaps between casework and abutting surfaces.

E. Drawer and door pulls shall be installed centered on drawers. If not shown or if two pulls are required, coordinate locations with Owner’s Representative.

3.4 INSTALLATION OF CABINET HARDWARE

A. Finish hardware shall be carefully fitted and secured in place.

B. Locations and positioning shall be in accordance with approved shop drawings.

C. Coordinate final required edge distance and locations of pulls with Own’s Representative. All holes shall be drilled at the jobsite in accordance with locations approved by Own’s Representative.

D. Adjust hardware to center doors and drawers in openings, with uniform gap at perimeter of doors and drawer fronts, and for unencumbered operation.

3.5 ADJUSTING AND CLEANING

A. Adjust moving or operating parts to function smoothly and correctly.

B. After installation, wipe finished surfaces to remove marks of handling, and leave in clean condition.

C. All damaged, stained, scratched, or otherwise disfigured portions of the work shall be touched up, refinished, or replaced to satisfaction of the Own’s Representative.

END OF SECTION

SECTION 06 64 20

GLASS-FIBER-REINFORCED PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Glass-fiber-reinforced plastic (FRP) wall paneling.

B. Related Requirements:
   1. Joint Sealants: Section 07 92 00.
   2. Gypsum Board: Section 09 29 00.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures: Action Submittals shall be submitted in accordance with Section 01 33 00, "Submittal Procedures."

1.3 ACTION SUBMITTALS

A. Shop Drawings:
   1. Dimensioned plans and elevations, drawn to scale.
   2. Large-scale details identifying components used, and indicating method of attachment.

B. Product Data: Manufacturer's literature describing materials and installation instructions.

C. Verification Samples:
   1. FRP panels, (To be selected by Architect).

1.4 QUALITY ASSURANCE

A. Materials and installation shall meet USDA/FSIS requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

B. Immediately upon delivery to jobsite, place materials in area protected from weather.

C. Protect materials from breakage and damage while unloading and when stored.

D. Comply with additional requirements specified in Section 01 60 00, "Product Requirements."

PART 2 - PRODUCTS

2.1 WALL PANELING

A. (WC-1) Glass-Fiber-Reinforced Plastic (FRP) Wall Panels: (To be selected by Architect).
   1. Size: 48 inches wide x [as indicated in drawings].
   2. Thickness: 0.090 inch, minimum.
   3. Flame Spread, ASTM E84: Class A.

4. Smoke Developed, ASTM E84: Under 450.
5. Water Absorption: Not over 0.16 percent.
6. Texture: (TBD). Color: As indicated on Drawings.

B. Trim: Matching PVC moldings for corners, end caps, and division bars.

2.2 OTHER MATERIALS

A. Sealant: Silicone type, as provided by panel manufacturer. Color to match wall panels.

B. Adhesives: VOC compliant, high quality, low odor, non-flammable, water and mold resistant, latex-based as recommended or provided by panel manufacturer.

C. Provide fasteners, trim, clips, cleaner, and other materials as recommended by panel manufacturer and required for a complete installation.

PART 3 - EXECUTION

3.1 WALL PANELING INSTALLATION

A. Set panels on top of flooring base. Secure to walls with adhesive in accordance with panel manufacturer's instructions.

B. Install matching trim at joints, corners, and other exposed edges.

C. Install panels vertically, cut to required height, without horizontal joints. Where used as a wainscot 48-inches or less in height, install horizontally without vertical joints except where wall length exceeds maximum available panel length. Joints shall be balanced on each wall with each end panel of equal width or length and not less than one-half full size.

D. Seal gaps remaining after installation, using silicone sealant.

3.2 CLEANING

A. Clean soiled or discolored surfaces after installation.

B. Remove and replace damaged or improperly installed work.

END OF SECTION

SECTION 07 21 17

THERMAL BLANKET INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Batt insulation at exterior framed walls.

B. Related Requirements:
   1. Acoustical Insulation and Sealants: Section 09 82 00; interior acoustic insulation and sound isolation requirements.
   2. Plumbing: Division 22; plumbing pipe insulation.
   3. Mechanical: Division 23; mechanical pipe and duct insulation.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures: Action Submittals shall be submitted in accordance with Section 01 33 00, "Submittal Procedures."

B. Coordinate design and spacing of furring and fiberglass clips securing insulation with attachment requirements of respective rainscreen system.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications and installation recommendations for each type of insulation required.
   1. Provide Underwriter's Laboratory approval numbers for required fire ratings.
   2. Approval of other laboratories is contingent upon acceptance by applicable authorities.

B. Delegated-Design Services: Provide engineering calculations for furring and anchor clips used for securing exterior board insulation and attachment of wall cladding system substantiating the members, spacing, fastening, and details shown on the shop drawing. Calculations shall be signed and sealed by the engineer in responsible charge retained by the Contractor. Engineer shall be a California licensed civil or structural engineer.

1.4 QUALITY ASSURANCE

A. Thermal resistance factors (R-values) listed are aged values tested in accordance with ASTM C518 at 75 degrees F and 50 percent relative humidity for at least six months.

B. Insulation shall be certified by manufacturer to comply with State standards for insulating materials.

C. Regulatory Requirements:
   1. Insulation shall be certified by manufacturer to comply with state standards for insulating materials.
   2. Insulation shall comply with Flame Spread Rating and Smoke Density requirements of CBC.

D. Foam insulation shall comply with CBC.

E. Mockups:
1. First area or example of each type of installation shall serve as a mockup for review of workmanship by Architect.
2. Do not proceed with installation until mockup is approved.
3. Comply with additional requirements of Section 01 43 39, “Mockups.”

1.5 DELIVERY, STORAGE, AND HANDLING

A. Clearly identify manufacturer, contents, brand name, applicable standard, and R-value.

B. Store materials off ground, protected against weather, condensation, and damage.

C. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

D. Comply with additional requirements specified in Section 01 60 00, "Product Requirements."

PART 2 - PRODUCTS

2.1 BLANKET INSULATION

A. General: Provide sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

B. Foil-Faced Fiberglass Blankets: Lightweight fiberglass with Foil Faced Insulation with PureFiber Technology, flexible insulation, formaldehyde free, conforming to ASTM C665 Type II, Class C, Category 2; “EcoTouch PINK Fiberglas Insulation” by Owens Corning, “Formaldehyde-free” Kraft-faced insulation by Johns Manville, “CertaPro” Thermal Kraft Faced Batts by CertainTeed Corporation, or equal.
1. Fire Resistive Requirements: ASTM E84.
a. Facing: No requirements.
b. Blanket:
1) Smoke Developed: 50 or less.
2) Flame Spread: 25 or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas scheduled to receive insulation to ensure protection against inclement weather and other hazards and to verify that work of preceding trades is completed.

B. Examine space allocated for insulation for proper depth to receive material.

C. Proceed with installation when conditions are satisfactory.

D. Prior to closing walls or ceilings, obtain Architect's observation of insulation installation.

3.2 INSTALLATION OF THERMAL BLANKETS

A. Install faced blankets with facing to building interior.

B. Install to fill all typical and odd spaces completely in framing where required, other than providing air space where indicated.

C. Install snugly between framing members. Provide straps to prevent sagging at vertical applications exceeding 8 feet, and netting at horizontal applications, to prevent sagging. If faced batts have tabs, tape tabs to metal studs to prevent sagging.

D. Trim to required height and width in place.

E. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations. Split blankets around wires as required.

F. Where wall blankets are not in contact with gypsum board, provide straps to prevent sagging.

G. Shim space between framing and window and door jambs shall be filled solid with unfaced batt or foam-in-place insulation. Fill spaces completely to a uniform monolithic density without voids.

END OF SECTION

SECTION 07 27 13

SHEET MEMBRANE AIR BARRIER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Vapor permeable air barrier membrane applied over sheathing and referred to on the Drawings as a “Water Resistant Barrier.”

B. Related Requirements:
   1. Joint Sealants: Section 07 92 00.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
   1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00 “Submittal Procedures.”

B. Closeout Submittals shall be submitted in accordance with Section 01 77 00 “Closeout Procedures” and Section 01 78 36 “Warranties.”

C. Pre-installation Meeting: Prior to application of air barrier and associated work, Design Builder, manufacturer's representative, and applicator shall meet at the Project site to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

D. Coordinate installation of air barrier with other trades to assure proper and adequate provision in the work of those trades for interface with the air barrier system.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Large scale, dimensioned drawings specific to the Project to supplement manufacturer data and standard details. Show the following:
   1. Details of typical and atypical conditions.
   2. Intersections with other envelope systems and materials.
   3. Membrane counterflashings.
   4. Details showing bridging of gaps in the construction, treatment of inside and outside corners and sealing of miscellaneous penetrations.

B. Product Data: Manufacturer's material specifications, use limitations, and installation instructions. Include manufacturer's written instructions for evaluating, preparing, and treating substrate. Data shall include certified test report showing compliance with requirements specified for ASTM E2178.

C. Samples: Representative samples of the following, if requested:
   1. Membrane material applied to suitable panel backing.
   2. Transition membrane.
   3. Through wall flashing.

1.4 INFORMATIONAL SUBMITTALS

A. Minutes of pre-installation meeting.

B. Qualifications as specified.

1.5 CLOSEOUT SUBMITTALS

A. Extended warranty.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with manufacturer's requirements, NRCA standards, and ASTM D6135.

B. Installer Qualifications and Requirements:
1. At least 5 years' experience installing self-adhering weather barrier systems.
2. Use adequate numbers of skilled workers thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the weather barrier.
3. Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.

C. The Owner may engage an independent consultant to observe the work during application to ascertain compliance with the specified requirements. Provide safe access to work areas and information necessary for Owner's consultant to accomplish observation.

D. Mockup: Before beginning installation of air barrier, provide a mockup area of no less than 100 square feet which will include at least one inside corner, one outside corner, and one penetration, one rough opening transition, overlying insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.
1. Design Builder shall secure attendance of authorized representative of material manufacturer during preparation of mockup.
2. Mockup shall be installed by same crew or personnel scheduled to do the Work.
3. If mockup does not comply with requirements, reconstruct and apply weather barrier until mockup area is approved.
4. Approved mockup may remain as part of the Work.
5. Comply with additional requirements of Section 01 43 39 "Mockup Requirements."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in labeled packages.

B. Store and handle in strict compliance with manufacturer's instructions, recommendations, and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

C. Comply with additional requirements specified in Section 01 60 00 "Product Requirements."

1.8 FIELD CONDITIONS

A. Apply weather barrier within the range of ambient and substrate temperatures recommended by weather barrier manufacturer.

B. Protect substrates from environmental conditions that affect performance of weather barrier.

C. Do not apply weather barrier to a wet substrate or during rain, fog, or mist.
1. Mockup shall be installed by same crew or personnel scheduled to do the Work.
2. If mockup does not comply with requirements, reconstruct and apply air barrier until mockup area is approved.
3. Approved mockup may remain as part of the Work.
4. Comply with additional requirements of Section 01 43 39, “Mockup Requirements.”

1.9 GUARANTEE AND WARRANTY

A. Design Builder: In addition to its standard Contract guarantee, furnish Owner with a special guarantee agreeing to remove and replace other work, as required, that has been connected to or superimposed over vapor barrier material to be replaced under manufacturer’s warranty.

B. Manufacturer: Furnish Owner with manufacturer's 5-year warranty that air barrier and accessories are free of defects at time of delivery and are manufactured to meet manufacturer's published physical properties and material specifications. Warranty shall be on manufacturer standard form. Failures include, but are not limited to, the following:
1. Failure to maintain air permeance rating not to exceed 0.004 cfm/square foot when tested in accordance with ASTM E2178, within specified warranty period.
2. Failure to maintain a vapor permeance rating greater than 10 perms when tested in accordance with ATM E96, Method B.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. General:
1. Weather barrier shall be capable of performing as a continuous vapor-permeable weather barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration.
2. Weather barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
3. Products shall be compatible with one another and with other specified or existing materials with which they may come in contact.

B. The building envelope has been designed and shall be constructed with a continuous weather barrier to control air leakage into and out of the conditioned space:
1. It shall be continuous with all joints made airtight.
2. The weather barrier shall be joined in an airtight and flexible manner to the weather barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep.
3. Penetrations of the weather barrier and paths of air infiltration/exfiltration shall be made airtight including fastener locations for furring, anchors, and relief angles.

C. Weather barrier shall meets Air Barrier Association of America (ABAA) requirements for “Adhesive Backed Commercial Building Wraps.”

D. Performance Characteristics:
1. Membrane Air Permeance: Not to exceed 0.00002 cfm/sq. ft. of surface area when applied to specified thickness at 1.57-lbf/sq. ft. pressure difference when applied to CMU wall and tested in accordance with ASTM E2178.
2. Membrane Vapor Permeance: Not less than 50 perms when tested in accordance with ASTM E96, Method B.
3. Assembly Performance: Provide a continuous air barrier assembly that has an air leakage not to exceed 0.002 cfm/sq. ft. of surface area under a pressure differential of 1.57 pounds per square foot when tested in accordance with ASTM E2357.
4. Multi-Story Wall Assembly Burn Test: Passed in assembly tested and acceptable for use in various wall assemblies per engineering analysis in accordance with NFPA 285.
5. Surface Burning Characteristics: ASTM E84.
   a. Flame Spread: 5.
   b. Smoke Developed: 15.
   c. NFPA Class A.
6. UV Exposure: Capable of sustaining minimum 6 months UV exposure prior to installation of overlying materials.
7. Water Penetration Resistance Around Nails, ASTM E331: Pass.

2.2 MEMBRANE MATERIAL

A. Vapor Permeable Membrane Air Barrier: “Perm-A-Barrier VPS” manufactured by GCP Applied Technologies, Inc. as specified and the basis of design, or equal.

2.3 ACCESSORIES

A. Transition Membrane: A 36 mil thick self-adhesive rubberized asphalt membrane integrally bonded to 4 mil thick cross-laminated, high-density polyethylene film to provide a minimum 40 mil thick membrane; “Perm-A-Barrier Detail Membrane.”

B. Self-Adhering Flashing Membrane: 40 mil thick, self-adhesive tape of rubberized asphalt integrally bonded to a high density, cross-laminated, polyethylene film; "Perm-A-Barrier Wall Flashing" by GCP Applied Technologies, Inc., or equal.
1. Width: As selected for conditions of use from manufacturer’s standard roll widths.

C. Primer: Water-based.
1. Air Barrier Membrane: “Perm-A-Barrier Primer Plus.”
2. Transition and Flashing Membranes: “Perm-A- Barrier WB Primer.”

D. Liquid Membrane for Detailing, Patching, and Terminations: Two-component, 100 percent solids modified urethane, cold-applied; "Bituthene Liquid Membrane," or equal.

E. Sealant in Contact with Membrane: Neutral one part silicone sealant, designed for adhering to low energy surfaces common in sheet or peel and stick weather resistant barriers, conforming to ASTM C920, Type S, Grade NS, Class 25; Sika “SikeHyflex – 407 EverFlash Universal”, Dow “758 Silicone Weather Barrier Sealant,” or equal.

F. Penetration flashing collars: prefabricated (QuickFlash) collars or custom sheet metal flashing collars with 4 in. flanges and fully soldered seams.

G. Self-Adhering Transition Flashing: 40 mil thick, aluminum faced, self-adhesive rubberized asphalt integrally bonded to a high density, cross-laminated, polyethylene film; "Perm-A-Barrier Aluminum Flashing."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Applicator shall examine the areas and conditions under weather barrier work will be performed.
   1. Report unsatisfactory conditions in writing.
   2. Do not proceed until unsatisfactory conditions are corrected.

B. All surfaces must be dry, sound, clean, free of oil. grease, dirt, or other contaminants detrimental to the adhesion of the weather barrier and flashings. Fill voids and gaps in substrate greater than 7/8 inch width to provide an even substrate.

3.2 PREPARATION

A. Ensure that the sheathing is stabilized with moisture content within limits required of weather barrier manufacturer and with corners and edges fastened. Fasteners in sheathing should not be over driven but should sit with only the head of the fastener proud of the surface.

B. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions.
   1. Remove contaminants such as grease, oil, curing compounds, or wax from exposed surfaces.
   2. Fill all voids and holes with approved patching compound or detailing sealant.

C. Primer:
   1. Apply primer at rate recommended by manufacturer, or approximately 300 square feet for gallon, to all areas to receive sheet membrane by roller or spray and allow minimum 30 minute open time.
   2. Primed surfaces not covered by sheet membrane during the same working day must be re-primed.

D. Detailing:
   1. Install detailing sealant cants and flashings at penetrations as detailed in the Drawings or as required by the manufacturer.
   2. Install detailing sealant cant at all inside corners.
   3. Install 6 inch wide reinforcing sheet of field membrane centered over detail cants at transitions in plane and at outside corners.

3.3 INSTALLATION

A. General:
   1. Comply with ASTM D6135, “Standard Practice for Application of Self-Adhering Modified Bituminous Waterproofing.”
   2. Refer to manufacturer’s literature for recommendations on installation except where more rigorous requirements are contained herein.
   3. Substrate surface shall be dry.

B. Apply barrier membrane according to the manufacturer’s instructions, within the manufacturer’s recommended application temperatures.

C. Install membrane vertically or horizontally, with laps shingled to shed water and overlapped a minimum of 2 inches.

D. Use a hand roller to firmly press the membrane into place.

E. Seal all membrane leading edges with sealant.

F. Seal around all cladding attachment fasteners.

G. Fit membrane tightly around penetrations and seal. Install penetration flashing collars over barrier membrane. Install transition membrane over top and side flanges of flashing collar.

3.4 TRANSITION MEMBRANE

A. Install strips, transition membrane, and auxiliary materials according to the barrier manufacturer's instructions to form a seal with adjacent construction and to maintain a continuous air and water membrane.
   1. Coordinate the installation of the barrier with installation of roofing membrane and base flashing to ensure continuity of barrier with roofing membrane.
   2. Install strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved on both substrates.

B. Apply primer to substrates to receive transition membrane at required rate and allow to dry.
   1. Limit priming to areas that will be covered by transition tape in same day. Reprime areas exposed for more than 24 hours.
   2. Prime gypsum sheathing not covered with membrane material with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal barrier membrane continuously to roofing membrane, membrane flashings under parapets, floor-to floor construction, exterior glazed assemblies, door framing, and other assemblies in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Prime concealed perimeter frame surfaces of exterior glazed assemblies and doors. Apply transition strip so that a minimum of 3-inch of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than one-inch of full contact.

G. Roll transition membrane firmly into place with a hand roller.

H. Fill gaps in perimeter frame surfaces of glazed assemblies, doors, and miscellaneous penetrations of barrier membrane completely with foam sealant.

I. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

J. Seal all membrane leading edges with sealant.

3.5 FIELD QUALITY CONTROL

A. Tests:
   1. Owner may engage a qualified testing agency to perform tests and inspections and prepare test reports.
   2. Testing will be used to determined evidence of air leakage according to ASTM E1186, smoke pencil with pressurization or depressurization.

B. Inspections: Barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following.
   1. Continuity of barrier system is achieved throughout the building envelope with no gaps or holes.
   2. Continuous structural support of barrier system is provided.
   3. Site conditions for application temperature and dryness of substrates have been maintained.
   4. Maximum exposure time of materials to UV deterioration is not exceeded.
   5. Surfaces have been primed, if applicable.
   6. Laps in strips and transition strips comply with minimum requirements and are shingled in the correct direction (or mastic is applied on exposed edges), with no fishmouths.
   7. Termination mastic is applied on cut edges.
   8. Strips and transition strips are firmly adhered to substrate.
   9. Compatible materials have been used.
   10. Transitions at changes in direction and structural support at gaps are provided.
   11. Connections between assemblies (membrane and sealants) comply with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
   12. All penetrations are sealed.

C. Deficiencies:
   1. Do not cover barrier until it is tested and inspected by Owner's testing agency, unless the Owner decides not to have tests performed in which case cover barrier after work is reviewed and found acceptable.
   2. Correct deficiencies in or remove barrier components that do not comply with specified requirements; repair substrates and reapply.

3.6 CLEANING

A. Upon completion of the Work, remove all debris and surplus items from the site. Leave all areas and building components in an acceptable condition for the remaining work.

3.7 PROTECTION

A. Protect completed membrane from subsequent construction activities and the environment as recommended by manufacturer.

B. Apply overlying materials as soon as possible. Apply temporary protection from UV exposure if product will be left uncovered for more than 30 days.

END OF SECTION

SECTION 07 40 00

METAL ROOF AND WALL PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section Includes:
1. Structural metal roof and all panels.
2. Through-fasten panel panel.
3. Factory finishing.
4. Metal trim and accessories and miscellaneous components: Flashings, fasteners, and accessories as required for weatherproof installation.

B. Related Requirements:
1. Section 05 12 00 - Structural Steel Framing: Roof framing and purlins.
2. Section 06 10 53 – Rough Carpentry
3. Section 06 16 43 – Gypsum Sheathing

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action Submittals shall be submitted in accordance with Section 01 33 00, "Submittal Procedures."
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures,” and Section 01 78 36, “Warranties.”
3. 3. Sustainable Design: Information necessary to establish and document compliance with the California Green Building Standards Code (CALGreen) goals for this Project.

1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 33 00.

B. Product Data: For each type of product indicated, demonstrate compliance with specified attributes. Manufacturer's data sheets on each product to be used, including:
1. Summary of test results, indicating compliance with specified requirements.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Specimen warranty.

C. CAL-GREEN Submittals: Product Data.
1. VOC Limits: For adhesives sealants, fillers, primers and coatings, documentation including printed statement of VOC contents, comply with limits specified in related section.
2. Product Test Reports: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement and demonstrate Cool Roof Rating Council (CRRC) listing.

D. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, details of trim, gutter, ridge, curved panel and flashing conditions, fastening and anchorage methods, weatherproofing techniques, terminations, and flashing of each type of penetrations, and special conditions.

1. Show work to be field-fabricated or field-assembled.
2. Include structural analysis signed and sealed by qualified structural engineer, indicating conformance of roofing system to specified loading conditions.
3. Indicate metal thickness and finishes, panel lengths, joining details, anchorage details, flashings and special fabrication provisions for termination and penetrations; purlin and girt locations, thermal expansion provisions and special supports.
4. Include roof plan showing clip spacing at ridge, eave and field.
5. Indicate relationships with adjacent and interfacing work. Demonstrate continuity of air barriers with related wall assemblies and roof underlayment.
6. Shop drawings must be completed by the metal roof panel manufacturer's engineering department.
7. All changes recommended by Contractor must be approved by the manufacturer in writing prior to submittal.

E. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches square, representing actual roofing metal, thickness, profile, color, and texture.
1. Include typical panel joint in sample.
2. Include typical fastening detail.

G. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.4 INFORMATIONAL SUBMITTALS

A. Delegated-Design Submittal: For metal roofs indicated to comply with performance requirements and design criteria, substantiating system performance, structural capacity, anchorages and fasteners sizes and spacings per specified criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and anchorage of metal roofs.
2. Include design calculations.
3. Provide clip fastener pull-out test report and calculations.

B. Qualification Data: For qualified Installer and testing agency.

C. Professional Engineer Qualifications: Demonstrate compliance with specified requirements.

D. Preconstruction Test Reports: For sealant.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance with performance requirements. For each system provide test reports with shop drawings.

F. Design test reports:
1. Indicate fastener types and spacings; and provide fastener pullout values.
2. Submit copy of manufacturer's structural II, California licensed, stamped, minimum design load calculations according to CBC Chapter 15.
3. Submit test results meeting or exceeding values specified in the Performance Criteria Article of this specification and stamped by an independent Testing Agency.

G. Certificates:
1. Manufacturer's Certificate that all products conform to specified requirements.

2. Manufacturer's Representative Certificate that installation conforms to specified requirements.

H. Quality-control reports.
1. Field quality-control reports.

I. Warranties: Sample of special warranties.

1.5 SCHEDULING AND SEQUENCING

A. Include in construction schedule:
1. When field measurement for factory production will be taken.
2. Order and delivery time.
3. Installation period.

B. Determine that work of other trades will not hamper or conflict with necessary fabrication and storage requirements for preformed metal roofing system.

C. Schedule field measurements far enough in advance, to permit fabrication of panels to required lengths without delay to the construction schedule.

D. Sequence installation to avoid other activities over metal roofing.

E. Do not cover underside of metal roofed areas until water intrusion test has been performed.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacture of roofing systems similar to those required for this project.
1. Not less than 5 years of documented experience.

B. Installer Qualifications: Company specializing in the type of work specified, with not less than five (5) years of documented experience; trained and authorized by roofing system manufacturer with written certification from manufacturer.
1. Maintain a full-time supervisor/foreman with minimum of five (5) years experience with the installation of system similar to that specified on the job-site at all times during installation of new roof system.
2. Upon Owner request, fabricator/installer shall submit work experience and evidence of adequate financial responsibility. The owner's representative reserves the right to inspect fabrication facilities in determining qualifications.

C. Delegated Design: Design metal roof assembly components and anchorages under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at California.

D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of assemblies that are similar to those indicated for this Project in material, design, and extent.

E. Engineering Responsibility: Prepare design for metal roof systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

F. Manufacturer's Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

G. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
   1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.

B. Store roofing panels on project site as recommended by manufacturer to prevent damage to panels prior to installation.

C. Order materials based on field measurements, not on construction drawings.

D. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 - Product Requirements.

E. Coordinate delivery schedule with installation schedule. Do not deliver materials of this section to project site until suitable facilities for storage and protection are available.

F. Protect materials from damage during transit and at project site. Store under cover, off ground, sloped to provide positive drainage, protected from wind, foreign material contamination, mechanical damage, cement, lime or other corrosive substances. Do not expose materials with strippable protective film to direct sunlight or extreme heat.
   1. Store preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
   2. Provide protective interleaving between contact areas of exposed surfaces to prevent abrasion during shipment, storage, and handling.
   3. Prevent contact with materials which may cause discoloration or staining

G. Inspect materials upon delivery. Reject and remove physically damaged or marred material from project site.

H. Do not allow storage of other materials or allow staging of other work on installed metal panel roof system.
   1. Do not overload roof with stored materials.
   2. Do not support roof mounted equipment directly on roofing system.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Finish Warranty: Provide manufacturer’s special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of 20 year period from date of Substantial Completion.

C. Waterproofing Warranty: Provide manufacturer's warranty for watertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water within specified warranty period of 30 years from date of Substantial Completion.
   1. Warranty must cover calculated wind speed.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Roof Panel System: Provide roof system with performance as specified when installed, designed in accordance with applicable codes.
   1. Make watertight.
   2. Make free from objectionable warp, wave and buckle.

B. Provide structural performance appropriate to substrate over which roof system is installed.

C. Design and size components to withstand loads caused by wind pressures as specified in applicable code.

D. Capacities for gauge, span or loading other than those tested may be determined by interpolation of test results within the range of test data. Extrapolation for conditions outside test range are not acceptable.

E. Drainage: Provide positive drainage to exterior for moisture entering building enclosure or condensation occurring within exterior building envelope.

2.2 MANUFACTURERS

A. Basis of Design Manfacturer for Metal Roof Panels: PBR panel – Exposed Fastening System, MBCI, Tel. 844.327.1748; Web: mbci.com.

B. Basis of Desigh Manufacgturer: MBCI metal panel.

C. Obtain all components of roof system from a single manufacturer including good materials if required to comply with metal roof manufacturer warranty. Secondary products required which cannot be supplied by the specified metal roof manufacturer must be those recommended and approved in writing by the specified metal roof manufacturer.

D. Substitutions: See Section 01 60 00 - Product Requirements.
   1. Requests for substitution of proposed alternate systems must meet or exceed all performance requirements listed in Performance Criteria, Warranty and Quality Assurance Articles.
   2. Submit complete product and test data for each proposed substitution.

2.3 ROOF PANELS

A. PBR metal panel, an exposed fastening system; Metal Roof Panels, with related metal trim and accessories. Basis of design Manufacturer: MBCI Company.

B. Roof and Wall panels: Structural Metal Panels consisting of an exterior metal panels with ribs 12" on center spacing with an exposed fastening system. Standard 26 gauge metal with rib height of 1 1/4 inch.

C. 36” wide panels, with exposed fastening system.

D. Coatings: Galvalume Plus, Galvanized with Acrylic Coating – Signature 200.

E. Finishes: Smooth (Standard).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.
   1. Determine if work of other trades which penetrates the roof or is to be made watertight by the roof is in place and approved prior to installation of roofing.
   2. Verify pipes, sleeves, or vents through roof are solidly set, reglets are in place, and nailing strips located.
      a. Locate penetrations in the center of roofing panel.
   3. Verify roofing termination, base flashings and gutter flanges are in place, sealed, and secure.
   4. Notify Architect in writing if substrates are not suitable for application of panel system.
   5. Do not proceed with installation until substrates are acceptable.

B. Structural surfaces: Smooth, even, sound, surface dry 19 percent maximum, clean and free of depressions, waves, or projections before material is applied.
   1. Examine the alignment and placement of the building structure and substrate. Correct any objectionable warp, waves or buckles in the substrate before proceeding with installation of the preformed metal roofing. The installed roof panels will follow the contour of the structure and may appear irregular if not corrected.

C. Apply no materials during wet weather or on wet surface.

3.2 INTERFACE WITH OTHER WORK

A. Coordinate with roof accessories, miscellaneous sheet metal accessories, piping vents and other items specified in related sections penetrating metal roofing work. Avoid conflict or omission in waterproofing systems and provide watertight installation.

3.3 PREPARATION

A. Verify field dimensions prior to ordering materials.
   1. Establish straight side and crosswise benchmarks.
   2. Check rectangular roofs for squareness and straightness. Gable ends may not be straight; set a true line for the gable clips and flashing with stringline.
   3. Measure the roof lengthwise to confirm panel lengths, overhangs, coverage of flashings at eaves and ridges and verify clearances for thermal movement.

3.4 INSTALLATION

A. Overall: Install roof system when the atmospheric dry bulb temperature is minimum forty (40) degrees Fahrenheit and rising

B. Accessories: Install all components required for a complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.
   1. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

C. Flashings: Coordinate to provide weathertight conditions at roof terminations. Fabricate and install in accordance with standards of SMACNA Manual.

D. Install 1 layer of underlayment on roof deck before installing preformed metal roof panels. Secure by methods acceptable to roof panel manufacturer, minimizing use of metal fasteners. Apply from eaves to ridge in shingle fashion, overlapping horizontal joints a minimum of 4 inches and side and end laps a minimum of 6 inches. Offset seams in successive layers of underlayment.

E. Comply with all details and install roofing materials and flashings in accordance with approved shop drawings and MBCI's manufacturer's product data within specified erection tolerances.

3.5 FIELD QUALITY CONTROL

A. A. Testing:
   1. Re-test until roof is shown to be watertight.

B. B. Manufacturer Field Services: Provide daily site inspection for a minimum of one (1) hour during active roofing operations by an experienced, full time employee of the roofing manufacturer. Submit written reports as specified.

3.6 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

B. Touch up minor abrasions and exposed fasteners with matching paint provided by panel manufacturer. Remove and replace panels that cannot be satisfactorily touched up.
   1. No exposed sealant or visible raw metal.

C. Sweep and remove chips, shavings, and dust from roof on a daily basis during installation period. Leave installed work clean, free from grease, finger marks and stains.

D. Upon completion of installation, remove scraps and debris from project site.

3.7 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before the Date of Substantial Completion.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Sheet metal for maintaining weather and water resistance of building enclosure, edge metal, flashing, and trim.
   a. Rain drainage including gutters, conductor heads, downspouts and scuppers.
   b. Parapet coping.
   c. Gravel stops.
2. Roof flashing not provided under Divisions 22 through 28 or roofing Sections.
3. Rain drainage including gutters, conductor heads, downspouts and scuppers.
4. Manufactured sheet metal accessories.
   a. Soffit and roof vents.
   b. Reglets, pressure and termination bars.
5. Sealant work related to sheet metal flashing and trim.

B. Related Requirements:
1. Metal Roof and Wall Panels: Section 07 40 00; sheet metal flashing and trim.
2. Sheet Metal Roofing: Section 07 61 00; sheet metal flashing and trim in conjunction with sheet metal roofing.
3. Flexible Flashing and Underlayment: Section 07 65 00.
4. Joint Sealants: Section 07 92 00.
5. Painting and Coating: Section 09 90 00.
6. Louvers and Vents: Section 08 91 10.
7. HVAC: Division 23; mechanical equipment.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action Submittals and Informational Submittals shall be submitted in accordance with Section 01 33 00, "Submittal Procedures."
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures” and Section 01 78 36, “Warranties.”

B. Pre-installation Meeting: Prior to installation of sheet metal associated work, Architect, Contractor, Construction Manager, and fabricator’s field and office representatives responsible for work under this Section shall meet at the Project site to coordinate and discuss sheet metal practices applicable to this Project.
1. Notify participants at least 5 business days before conducting meeting.
2. Record discussions of conference and any conflict, incompatibility, or inadequacy. Furnish a copy of record to each participant.
3. At Contractor’s option, agenda for sheet metal discussion may be included as part of pre-installation conferences required for other building assemblies and specified under other Sections.

C. Coordinate with shop drawing, mock-up, and warranty requirements of other Sections installed in conjunction with work of this Section.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Fully detailed, large-scale drawings for fabrication and installation layout of sheet metal flashing and trim including plans, elevations, and keyed details. Distinguish between shop and field-assembled work. Include the following:
1. Identification of material, thickness, weight, and finish for each item and location in project.
2. Details for forming sheet metal flashing and trim including profiles, shapes, seams, and dimensions.
3. Details for securing, joining, supporting, and anchoring sheet metal flashing and trim including fasteners, cleats, clips, and other attachments.
4. Details for expansion-joint covers including showing direction of expansion and contraction.
5. Details showing interface and relationship to adjacent materials.
6. Details of special conditions.

B. Product Data: Manufacturer's catalog cuts for manufactured items.

C. Samples:
1. Exposed Sheet Metal Flashing: Nominal 12-inch long section of typical flashing with shop-applied finish applied in step fashion to show pretreatment and each applied coating.
2. Concealed Metal Flashing: Nominal 12-inch long section of pan or head flashing showing soldered or welded corners.
3. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
4. Accessories and Miscellaneous Materials: Full-size Sample.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification of fabricator.

B. Verification of certification of coating applicator by coating manufacturer.

C. Record of pre-installation conference, if not included under other Sections.

1.5 CLOSEOUT SUBMITTALS

A. Extended guarantee and warranty.

1.6 MAINTENANCE SUBMITTALS

A. Touch-up paint as specified.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

C. Deliver sheet metal flashing materials and fabrications undamaged. Project sheet metal flashing, trim materials, and fabrications during transportation and handling.

D. Comply with additional requirements specified in Section 01 60 00, "Product Requirements."

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Industry Standards:
1. Conform to applicable provisions of the "Architectural Sheet Metal Manual" of the Sheet Metal and Air Conditioning Contractors' National Association Inc. (SMACNA Manual), except where more stringent requirements are specified or shown.
2. Conform to applicable provisions of NRCA Roofing and Waterproofing Manuals.

B. Installed flashing and sheet metalwork shall be weathertight.

C. Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction.

D. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

E. Provide sheet metal flashing and trim that allows for thermal movement resulting from the maximum ambient and surface temperatures expected by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrates are smooth and clean to extent needed for sheet metalwork.

B. Verify that nailers, cants, and blocking to receive sheet metal are installed and suitable to receive sheet metalwork.

C. Before installing sheet metal, verify shapes and dimensions of surface to be covered.

D. Notify the Architect of any discrepancies between the Drawings and field conditions, and of any elements that required repair.

E. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to installer or applicator. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION

A. Comply with details and profiles shown and the SMACNA "Architectural Sheet Metal Manual" recommendations for installation of the work.

B. Fastenings shall be concealed. Exposed fasteners, if proposed, shall be approved by the Architect.

C. Installed work shall be watertight, without waves, warps, buckles, fastening stresses, distortion, "oil canning," shall be true to line and surface, and shall allow for expansion and contraction.Maximum Deviation from Alignment When Erected: 1/4 inch in 20 feet, non-cumulative.

3.3 FIELD QUALITY CONTROL

A. Maximum Deviation from Alignment When Erected: 1/4 inch in 20 feet, non cumulative.

3.4 CLEANING AND TOUCH-UP

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.Touch up shop-applied primer on galvanized sheet metal, and paint as specified in Section 09 90 00, "Painting and Coating."

C. Clean finished surfaces in accordance with manufacturer's instructions. Clean and neutralize flux materials. Clean off excess solder.END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Through-penetration firestop systems:
2. Fire-rated joint systems:

B. Related Requirements:
1. Thermal Board and Blanket Insulation: Section 07 21 17.
2. Non-Structural Metal Framing:
3. Gypsum Board: Section 09 29 00; gypsum wallboard fireproofing at structural members.
4. Divisions 21 through 28: Infrastructure systems work requiring firestopping.

1.2 DEFINITIONS

A. Firestopping: A material, or combination of materials, to retain the integrity of time-rated construction by maintaining an effective barrier against the spread of flame, smoke and gases.

B. Other Definitions: Follow CBC.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures: Action Submittals and Informational Submittals shall be submitted in accordance with Section 01 33 00, "Submittal Procedures."

B. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures,” and Section 01 78 36, “Warranties.”

C. Coordination:
1. Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed in accordance with specified requirements.
2. Sequence work to permit firestopping to be installed after completion of penetrating item installation but prior to covering or concealing of openings.

1.4 ACTION SUBMITTALS

A. Shop Drawings:
1. Manufacturer's UL-approved assembly drawings are acceptable as shop drawings if they reflect actual job conditions.
2. For job conditions where no clearly defined UL-approved assembly exists, provide an engineering judgment from manufacturer. Where requested by Architect, submit drawings showing each condition to document proposed systems, materials, anchorage, methods of installation, and type of construction assembly being penetrated.
    a. Engineering judgments shall follow requirements set forth by the International Firestop Council.

b. Proposed system shall be acceptable to local governing authorities.

B. Product Data:
1. Manufacturer's specifications and installation instructions for all materials and prefabricated devices, providing descriptions sufficient for identification at the jobsite.
2. Installation details shall reflect actual job conditions.
3. Where available, include L rating indicating tested air leakage for products used in through-penetration systems.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's letter of certification or certified laboratory test report stating that materials or combination of materials meet requirements specified in ASTM E814 and classified as meeting these requirements in UL's Building Materials Directory.

B. UL Certificates of Compliance.

C. Qualification data for installer.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Firestopping installation shall meet requirements of Underwriters Laboratories Inc. (UL) Test UL 1479, "Fire Tests of Through-Penetration Firestops," or ASTM E814 and UL 2079.
2. Materials shall meet requirements of NFPA 101, "Life Safety Code" and NFPA 70, "National Electrical Code."

B. Installer Qualifications: A Firestop Specialty Contractor (FSC) experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.
1. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements.
2. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to installer engaged by Contractor does not in itself confer qualification on buyer.

C. Installation Responsibility: Assign installation of through-penetration firestop systems in Project to a single qualified installer.

D. Fire-Test-Response Characteristics: Firestopping shall comply with the following requirements and those specified under "System Performance Requirements" Article:
1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, ITS-Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested in accordance with ASTM E814 under conditions in which positive furnace pressure differential of at least 0.01 inch of water is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly. Systems shall comply with the following requirements:
a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.

b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in their "Fire Resistance Directory," by ITS-Warnock Hersey, or by another qualified testing and inspecting agency.

3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics in accordance with UL 2079 under conditions in which the positive furnace pressure differential is at least 0.01 inch of water, as measured 0.78 inch from face exposed to furnace fire. Systems shall comply with the following requirements:
   a. Fire Ratings of Joint Sealants: As indicated by reference to design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.
   b. Joint sealants, including backing materials, bear classification marking of qualified testing and inspection agency.

E. Mockups:
1. Concealed Locations: Seal one floor, one wall opening, and one fire-rated partition meeting metal deck as selected, under firestopping system manufacturer's supervision, to show completed system and to verify installation method and procedure.
2. Exposed Locations: Prepare and seal a typical penetration to be sealed with foam firestopping.
   a. Exposed surface shall be made smooth and suitable to receive a paintable surface.
   b. Installation shall be reviewed by the Architect.
   c. Modify mock-up as necessary until appearance is accepted.
3. In coordination with the building envelope assemblies, provide a mockup showing typical interface between floor slab and wall assembly.
4. Accepted mockups shall serve as a standard of workmanship and appearance for all penetrations remaining exposed in completed construction.
5. Comply with additional requirements of Section 01 4339, “Mockup Requirements.”

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened packages or containers clearly identifying manufacturer's names, brand designations, product descriptions, applicable standards, lot numbers, and test or rating labels.

B. Store materials off ground, protected against weather, condensation, and damage.

C. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

D. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 FIELD CONDITIONS

A. Do not install materials when temperatures exceed manufacturer's recommended limitations for installation. Maintain minimum temperatures before, during, and for 3 days after installation of materials.

B. Provide masking and drop cloths during installation to prevent firestopping materials from contaminating adjacent surfaces.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. General:
1. Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and passage of smoke and other gases.
2. For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E84.
3. Materials shall be compatible with each other and with other specified items with which they may come in contact and shall not cause corrosion of penetrating items.
4. Materials shall be free of solvents, asbestos, or PCBs, and shall be nontoxic to human beings at all stages of application and during fire conditions.
5. Firestopping shall remain sufficiently flexible after installation to accommodate expected vibration and movement between penetrating items and rated building components or assemblies or between adjacent building components or assemblies at joint systems, without affecting adhesion or integrity of system.
6. Materials shall not shrink noticeably after installation.
7. Caulk, foam, mortar, and putty materials shall be autobonding to permit changes to penetrating items.

B. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings as determined in accordance with ASTM E814 but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.

C. T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined in accordance with ASTM E814, where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where firestop systems protect the following types of penetrations:
1. Penetrations located outside of wall cavities.
2. Penetrations located outside fire-resistive shaft enclosures.
3. Penetrations located in construction containing doors required to have a temperature-rise rating.
4. Penetrating items larger than a 4-inch-diameter nominal pipe or 16 square inches in overall cross-sectional area.

D. L-Rated Systems: Where through-penetration firestop systems are located in smoke barriers, provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft at both ambient temperatures and 400 degrees F determined in accordance with UL 1479 or ASTM E814.

E. W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.

F. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per UL 2079, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.

G. For firestopping exposed to view, traffic, moisture, and physical damage, provide assemblies that do not deteriorate when exposed to these conditions.
1. At piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant, through-penetration, firestop systems.

2. At floor penetrations with annular spaces over 4 inches wide and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads, either by installing floor plates or by other means.
3. At penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
4. At joints involving metal deck or other construction with spray-on fireproofing, provide fire-resistive joint systems not requiring removal of spray-on fireproofing.
5. Rating of firestopping materials or system shall in no case be less than rating of rated floor or wall assembly.

H. Rain and Water Resistance: Provide perimeter joint sealant tested in accordance with ASTM D6904 with less than 1 hour tack free time as tested in accordance with ASTM C679.

I. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of 0 as determined by ASTM G21.

J. Floor through penetration firestopping materials shall be either “cast-in-place” (integral with concrete placement) or “post-installed.”
1. Cast-in-place firestop devices shall be provided prior to concrete placement.
2. Cast-in devices shall have the option to add post-installed water dam to meet field conditions.
3. Manufacturer’s representative shall be available to support the process of installing cast-in devices.

K. Fire and Sound-Rated Conditions: Use fire-rated acoustic sealants compliant with requirements specified in Section 09 8200, “Acoustical Insulation and Sealants.”

L. Cable trays shall not penetrate through rated assemblies. Trays shall terminate on both sides of the rated assembly and Hilti “Future Proof Plates” as specified, or equal, shall be used to allow for use of approved firestopping systems at the penetrations.

2.2 FIRESTOPPING MATERIALS

A. General:
1. Materials listed below are not necessarily all-inclusive, nor are all materials listed necessarily required to be used.
2. Although several manufacturers are listed for each type of firestopping and listed manufacturers also vary for each Type, Contractor shall develop systems for firestopping using approved systems from a single manufacturer unless products for required systems are not available from the selected manufacturer.

B. Job-Mixed Vinyl Compound: Prepackaged vinyl-based powder product for mixing with water at Project site to produce a paintable compound, passing ASTM E136, with flame-spread and smoke-developed ratings of zero per ASTM E84; “USG Firecode Compound” by United States Gypsum Co., or accepted equal.

C. Firestop Mortar: Prepackaged dry mix of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar; Hilti FS 637 “Firestop Mortar," or accepted equal.

D. Non-intumescent Firestop Sealant: One-part, non-hardening, silicone elastomer; Grace Construction Products Hilti CP 601S “Elastomeric Firestop Sealant," or accepted equal.

E. Mastic Firestop Sealant: Single component, water based, mastic grade; Rectorseal "Metacaulk 1100" or accepted equal.

F. Firestop Foam: Two-component silicone elastomer; Hilti CP 620 "Fire Foam," or accepted equal.
1. After dispensing, foam shall be fully expanded in 5 minutes and fully cured in 24 hours. Approximate density 16 pcf, with uniform cell structure.
2. Forming and Damming Materials, As Required: Mineral fiberboard or as selected by installer.
3. Primer, sealant, and solvent cleaner as recommended by foam manufacturer.

G. Intumescent Fire Blocks: Hilti "FS-657" or accepted equal (no known equal).

H. Flexible Firestop Spray Coating: Sprayable water-based coating; designed to form a flexible seal over mineral fiber firesafing; Hilti CP 672 "Speed Spray," or accepted equal.

2.3 FIRESAFING, ACCESSORIES, AND ADDITIONAL MATERIALS

A. Mineral Fiber Firesafing/Backing Material:
1. Unfaced Mineral Fiber: 4 pcf, suitable for friction fit in voids. Melt point 2000 degrees F minimum, ASTM C24. Ceramic or cementitious-blend fiber is also approved. Do not use glass fiber.
2. Foil Faced Mineral Fiber: Same as unfaced mineral fiber but with aluminum foil facing on one side.
3. Properties:
a. Noncombustible in accordance with NFPA Standard 220 when tested in accordance with ASTM E136.
b. Thermal Conductivity: 0.25 to 0.23 k-value per ASTM C518.
c. Surface-Burning Characteristics:
1) Flame Spread: 15 (10 to 25 with foil facing).
2) Fuel Contributed: 0 (5 with foil facing).
3) Smoke Developed: 0.

B. Accessories:
1. Provide joint fillers, packing, and other accessory materials required for installation of firestop sealants, as applicable to installation conditions indicated.
2. Provide primers, sealers, and solvent cleaners as recommended by firestopping manufacturers for specific substrate surfaces.
3. Provide impaling clips, cinch shields, and similar items required for installation of backing material.
4. Provide protective covers or devices for soft firestopping and firesafing products that will be exposed in finished construction.

C. Cast-in Firestop Devices: Hilti CP 680N and CP 682 “Firestop Cast-in Device,” CP 681 “Tub Box Kit,” and “Aerator Adaptor,” or accepted equal.

D. Other Facing and Backing Materials: As recommended by firestopping manufacturer(s). Use fire resistive material where possible.

2.4 MIXING

A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of

mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas scheduled to receive firestopping to ensure protection against inclement weather and other hazards and to verify that work of preceding trades is completed.

B. Examine space allocated for firestopping for proper depth to receive material.

3.2 PREPARATION

A. Clean surfaces to receive firestopping. Remove dirt, grease, oil, loose materials, rust and other substances that may affect bond, installation, and fire resistance.

3.3 INSTALLATION - GENERAL

A. Install backing materials, forms, clips, and other items as required to hold firestopping and firesafing in place.

B. Firestopping or firesafing shall completely fill void spaces, regardless of geometric configuration.

C. Use mineral fiber to fill gaps at fire-resistive joint systems, as a backing material for firestop sealants and calks, and elsewhere as permitted by code. Pack mineral fiber snugly into voids. Install firestop sealant to cover backing material completely. Do not use unfaced mineral fiber by itself for firestopping purposes.

D. Where the top edge of a fire-rated wall or partition abuts a fluted-type metal deck, provide firesafing to fill voids in a manner acceptable to governing authorities. Cover joint both sides with firestop sealant, or spray joint both sides with firestop coating.

E. Use foam, sealant, mortar, or ceramic fiber putty to firestop duct, conduit, and metal pipe penetrations at fire-rated construction.

F. At sound-rated fire-rated construction, use only permanently resilient firestopping materials.

G. Firestop ceiling penetrations from exposed side only. Firestop wall penetrations on both sides.

H. Fill voids behind firestopping with mineral fiber backing material.

I. Firestop space between penetrating element and sleeve or collar. Also, seal space between sleeve, collar, or penetrating element and adjacent construction.

J. Installation of Firestopping Sealants:
   1. Comply with manufacturer's printed instructions, except where more stringent requirements are shown or specified.
   2. Comply with ASTM C1193 for installation of elastomeric joint sealants.

K. Use firestop mortar or high-temperature calk at penetrations by high-temperature items such as steam piping, flues, and chimneys.

L. After curing, remove combustible backing materials.

M. Install protective covers or devices where applicable.

N. Maintain integrity over entire area to form a continuous fire stop.

O. Exposed sealant shall be trowelled smooth.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Exterior sealants not incorporated or interfacing with exterior façade assemblies and roofing assemblies specified or provided under other Sections.
2. Interior sealants.

B. Related Requirements:
1. Delegated Design: Section 01 33 25
2. Thermal Board and Blanket Insulation: Section 07 21 00.
3. Interior Glazing: Section 08 80 00; glazing sealants.
4. Acoustical Insulation and Sealants: Section 09 82 00.

1.2 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications, recommendations, and installation instructions, including cleaning of joint surfaces, for each sealant material to be used.

B. Samples: Color selection for each product exposed to view; manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available.

1.3 INFORMATIONAL SUBMITTALS

A. Statement of qualifications for applicator of exterior sealant.

B. Results of field adhesion testing.

1.4 CLOSEOUT SUBMITTALS

A. Extended warranty.

1.5 QUALITY ASSURANCE

A. Material Compatibility: Sealant materials shall be compatible with one another and with other specified and existing materials, under conditions of service and application required.

B. [Installer Qualifications for Exterior Sealants: A firm experienced in installing sealants similar to that those indicated for this Project, with a record of successful in-service performance, and acceptable to material manufacturers.]

C. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate indicated.
3. Notify Architect 7 days in advance of dates and times when test joints will be erected.

4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   b. Submit modified test method for review where joint configurations do not allow Method A.
6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with manufacturer’s labels. Labels on delivered materials shall show manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.7 WARRANTY

A. General:
   1. Repair or replace joint sealants that fail to achieve airtight and watertight seal or otherwise fail to perform as intended because of leaking, crumbling, hardening, shrinkage, bleeding, sagging, staining, loss of adhesion or cohesion, or do not cure within the specified warranty periods.
   2. Extended warranties specified in this Section exclude deterioration or failure of joint sealants from the following:
      a. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
      b. Disintegration of joint substrates from natural causes exceeding design specifications.
      c. Mechanical damage caused by individuals, tools, or other outside agents.
      d. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

B. Contractor: Provide Owner with a written 2-year warranty, co-signed by installer, agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

C. Manufacturer: Provide Owner with manufacturer's written 20-year warranty for sealant Types 1A and 1B agreeing to furnish sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty shall include failure due to loss of adhesion, weather seal. In addition, Type 1B sealant warranty shall include staining.
   2. Contractor shall be responsible for scheduling, arranging, and providing any print review and testing required by manufacturer as a condition for issuance of its warranty.

PART 2 - PRODUCTS

2.1 SEALANT MATERIALS

A. Colors:
   1. Concealed Material: Any of manufacturer's standard colors.
   2. Exposed Material: Manufacturer's standard colors, as selected by the Architect.

B. Type 1A - Sealant for General Exposed Exterior Use: One part, neutral cure, gun-grade silicone conforming to ASTM C920, Type S, Grade NS, Class 50; Dow Corning "795 Building Sealant," "SilPruf" by Momentive Performance Materials, or accepted equal.

C. Type 1B - Sealant for Use at Brick, Stone, Concrete and Other Porous Surfaces: One part, medium modulus, silicone polymer conforming to ASTM C920, Type S, Grade NS, Class 50 and formulated to reduce or eliminate dirt pickup, surface streaking, and substrate staining; Dow Corning "756 SMS," "SCS9000 SilPruf NB" by Momentive Performance Materials, or accepted equal.

D. Type 1C - Sealant in Contact with Self-Adhering Underlayment: One part, neutral cure, gun-grade silicone conforming to ASTM C920, Type S, Grade NS, Class 25; Dow Corning "758 Weather Barrier," or accepted equal.

E. Type 2A - Exterior Sealant for General Use: ASTM C920, Type S, Class 25, Grade NS, single-component, silyl-terminated polyether; BASF "Sonolastic 150," or accepted equal.

F. Type 4 - Concealed Bedding Conditions: One-part butyl-rubber calk conforming to FS TT-S-001657, Type I; Pecora "BC158," or accepted equal.

G. Type 5 - Exterior and Interior Small to Medium Width Horizontal Joints Subject to Pedestrian Traffic: One-part, self-leveling polyurethane conforming to ASTM C920, Class 25, Type S, Grade P; Pecora " NR-201," or accepted equal.

H. Type 6 - Interior Nonwet Areas: One-component acrylic latex water-based sealant conforming to ASTM C834; "Tremco "Acrylic Latex," or accepted equal.

I. Type 7 - Interior Wet Areas: One-part mildew-resistant silicone rubber conforming to ASTM C920, Type S, Class 25, Grade NS; Dow Corning "786," or accepted equal.

2.2 MISCELLANEOUS SEALANT MATERIALS

A. Paving Joint Backing for Interior Use: Preformed, self-expanding cork complying with ASTM D1752, Type III, or as recommended by paving sealant manufacturer.

B. Fiber Expansion Joint Material for Exterior Use: Preformed cellular fiber complying with ASTM D1751; 1/2 inch thick unless otherwise indicated; "SealTight Fiber Expansion Joint Filler" by W.R. Meadows or accepted equal.

C. Perimeter Gap Sealant: Gun-dispensed, foam polyurethane or polyisocyanurate type conforming to ASTM C1620; Hilti “CF 810/812,” or accepted equal.

D. Additional Sealant Materials: As specified in other Specification Sections.

2.3 SEALANT ACCESSORIES

A. Joint Primer/Sealer: As recommended by sealant manufacturer for joint surfaces to be primed or sealed.

B. Sealant Backer Rod: Compressible, rod-stock, as recommended for compatibility with sealant by sealant manufacturer and complying with ASTM C1330.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer. Provide self-adhesive tape where applicable.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that joint dimensions are not less than or greater than recommended by joint sealer manufacturer for application indicated.

B. Clean joint surfaces immediately before installation of sealant.
1. Remove dirt, insecure coatings, moisture, and other substances that would interfere with bond of sealant.
2. Etch concrete joint surfaces as recommended by sealant manufacturer.
3. Use cleaning solvent to clean all joint surfaces.
4. Wipe joints free of solvent, using clean, dry cotton cloths or lintless paper.
5. Do not permit solvent to air dry.

3.2 INSTALLATION

A. General:
1. Comply with manufacturer's printed instructions, except where more stringent requirements are shown or specified.
2. Comply with ASTM C1193 for installation of elastomeric joint sealants.

B. Prime or seal joint surfaces as recommended by sealant manufacturer.
1. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.
2. Prime anodized aluminum and painted surfaces using primer recommended by sealant manufacturer, unless sealant manufacturer certifies in writing, that primer is not required.

C. Install sealant backer rod for elastomeric sealants, except where recommended to be omitted by sealant manufacturer for application shown.

D. Install bond-breaker tape wherever backer rod is not used and wherever required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

E. Use only proven installation techniques that 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 a slightly concave surface, slightly below adjoining surfaces.
   2. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

F. Install sealants to depths as recommended by sealant manufacturer, but within following general limitations:
   1. For walkways, floor and similar joints subject to traffic, and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width but not more than 3/4 inch deep or less than 3/8 inch deep.
   2. For joints not subject to traffic, fill joints to a depth equal to 50 percent of joint width but not more than 1/2 inch deep or less than 1/4 inch deep.

3.3 SOUND ISOLATION

A. Sound-insulated partitions and floor/ceiling assemblies are indicated on the Drawings.

B. Seal sound-insulated partitions airtight with acoustical sealant, in accordance with ASTM C919 and manufacturer's recommendations. Install acoustical sealant at partitions where indicated on the Drawings.

C. Intersections: Hold gypsum board back a maximum of 1/4 inch from intersecting gypsum board with floor or other surfaces, and apply a bead of acoustical sealant. Caulk void full and airtight with acoustical sealant.

D. Penetrations:
   1. Penetrations by conduits, ducts, pipes, and around electrical junction boxes shall be sealed airtight.
   2. Holes smaller than 1 inch but too large to seal with sealant shall first be packed with mineral fiber and then sealed airtight.
   3. Holes larger than 1 inch shall first be packed with glass or mineral fiber, then sealed over with acoustical putty pads, and then sealed airtight.
   4. Backs of electrical junction boxes in acoustically rated construction shall be sealed airtight with specified pads.

E. Install pipe isolation system wherever a pipe penetrates a stud or framing member.

F. Coordinate sealing with requirements of Section 09 29 00, "Gypsum Board."

G. Where sound-insulated walls are fire rated, follow requirements of Section 07 84 00, "Firestopping."

H. Prior to closing walls, obtain Architect's observation of insulation installation.

3.4 FIELD QUALITY CONTROL

A. Sealant Adhesion Field Tests:

1. Prior to start of sealant application, construct a mock-up using specified surface preparation and sealant installation on:
   a. Stone, each Type.
   b. Aluminum framing.
   c. Any additional substrate on which exterior sealant is to be installed.
2. Notify Architect at least 48 hours prior to start of installation and testing.

B. Procedure for Sealant Adhesion Field Test:
1. Construct four 10 inch long x 1 inch wide x 1/4 inch thick strips of sealant over each substrate. Apply bond breaker tape to the substrate under the last 2 inches of the sealant at each end of the strips to provide a tab for peel testing.
2. Cure samples 21 days at minimum temperature of 50 degrees F.
3. After curing grasp strip sample end tabs and pull 90 degrees to the surface.
4. Acceptable application shall be cohesive failure (tearing within itself) with no adhesive (debonding) failure.
5. If sample debonds, the sealant manufacturer shall make written recommendations regarding changes in surface preparations or primers. Submit recommendations on the Architect for acceptance.
6. Repeat sealant adhesion trials as required to produce an acceptable application.

C. Sealant Manufacturer Shall:
1. Observe mock-up construction and testing.
2. Observe initial day of sealant installation.
3. Visit site and observe work at least once every two weeks.
4. Issue a written report recording surface preparation procedures, sealant application procedures, and stating the work conforms to the manufacturer's recommendations and these specifications. Note departures from these requirements and recommendations for necessary corrective actions.

3.5 CLEANING AND CURING

A. Clean adjoining surfaces to eliminate excess sealant.

B. Cure sealants in compliance with manufacturer's instructions and recommendations to obtain high early-bond strength, internal cohesive strength, and surface durability.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hollow metal doors and frames.

B. Related Requirements:
   1. Wood Doors: Section 08 14 00.
   2. Door Hardware: Section 08 71 00.
   3. Glazing: Section 08 80 00.
   4. Acoustic Insulation and Sealants: Section 09 82 00
   5. Painting and Coating: Section 09 90 00.
   6. Electronic Safety and Security: Division 28; door security system.

C. Coordination: Hardware supplier shall furnish steel door and frame manufacturer with accepted hardware schedule, hardware templates, and samples of physical hardware where necessary to ensure correct fitting and installation. Preparation includes sinkages and cutouts for mortise and concealed hardware.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Cover each type of door, frame, and frame condition
   1. Use same reference numbers for details and openings as those indicated on Drawings.

B. Product Data: Manufacturer's technical data substantiating that products comply with specified requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Test Reports for each type of fire-rated hollow metal door and frame assembly if not included as part of product data submittal.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel doors and frames in such a manner as to prevent damage or deterioration.

B. Provide such packaging as cardboard or other containers, separators, banding, spreaders, and paper wrappings in order to protect items during transit and Project site storage.

C. Follow special storage and handling requirements of manufacturer.

D. Inspect products upon delivery for damage. Minor damage may be repaired, provided that refinished items are equal in all respects to new work and acceptable to the Architect. Otherwise, remove and replace damaged items as directed.

E. Store doors upright in a protected dry area on a raised platform at least 1 inch off the ground. Provide blocking between units so as to provide air circulation.

F. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.5 FIELD CONDITIONS

A. Post-Set Frames: Prepared openings shall be properly located and sized, plumb and square. Do not force-fit frames into improperly constructed openings.

B. Preset Frames: Wall/partition and frame locations shall be accurately marked before frames are erected.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Doors and Frames: Ceco, Curries, Security Metal Products, or accepted equal SDI Certified manufacturer or member of the Hollow Metal Manufacturers Association (HMMA).

2.2 DESIGN AND PERFORMANCE CRITERIA

A. Steel doors and frames shall comply with ANSI A250.8.

B. Fire-Rated Assemblies: Wherever a fire-resistance classification is indicated, provide fire-rated steel doors and frames, investigated and tested as part of a fire door assembly, complete with type of fire door hardware to be used.
   1. Identify each fire-rated door and frame with permanent, metal labels, in accordance with NFPA Standard 252, UL 10C, and SFBC, from approved testing and inspection agency, indicating applicable fire rating.
   2. Fire rated assemblies shall be protected by tight fitting smoke and draft control assemblies, and include door and frame with fire rating label followed by a letter "S" for smoke and draft control rating.
   3. Construct and install assemblies in such a manner as to comply with NFPA Standard No. 252, or UL 10C and NFPA 80 and as specified herein.
      a. Labels: Place fire rating labels where visible when doors and frames are in installed, open positions.
      b. Temperature Rise Rating: Provide doors with maximum 450 degrees Temperature Rise Rating in 30-minute fire exposure period at doors into exit enclosures, exit vestibules, and horizontal exits.
   4. Pairs of doors with vertical-rod panic exit devices shall be labeled without use of overlapping astragals.
   5. Refer to Drawings for fire rating at rated openings.

C. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by an approved testing and inspecting agency based on testing according to NFPA 257 or UL 9.

D. Work shall meet applicable requirements of the Hollow Metal Manufacturers Association (HMMA), a Division of the National Association of Architectural Metal Manufacturers (NAAMM).

2.3 MATERIALS:

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A568 and ASTM A1011.

B. Cold-Rolled Steel Sheets: Commercial-quality carbon steel complying with ASTM A568 and A1008, exposed, matte finish, oiled.

C. Galvanized Steel Sheets: Commercial-quality zinc-coated carbon steel complying with ASTM A653 with A60 or G60zinc coating.

D. Supports and Anchors: Not less than 18-gage galvanized sheet steel.

E. Frame Anchors:
1. Typical: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
2. Anchors Built Into Exterior Walls: Steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M, hot-dip galvanized according to ASTM A153/A153M, Class B.

F. Inserts, Bolts, and Fasteners: Manufacturer's standard units, hot-dip galvanized according to ASTM A153/A153M.

G. Shop-Applied Paint: Rust-inhibitive primer, either air dried or baked on, suitable as a base for specified finish paints.

H. Glass: As specified in Section 08 80 00, "Glazing."

2.4 FABRICATION - GENERAL

A. Conform to requirements of SDI or NAAMM.

B. Fabricate hollow metal units to be rigid, neat in appearance and free from defects, warp or buckle. Accurately form metal to required sizes and profiles. Weld exposed joints continuously, grind, dress, and make smooth, flush and invisible. Metallic filler to conceal manufacturing defects is not acceptable.

C. Fabricate steel doors and frames to required profiles and sizes by forming with edges straight and sharp.

D. Doors and frames subject to exterior environmental conditions shall be fabricated from specified galvanized-steel sheets.

E. Fit and fabricate accurately with corner hairline joints and all surfaces free from warp, wave, buckle, and other defects.

F. Welding: In accordance with AWS standards for high-grade hollow metal work
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain complete fusion without discontinuity or undercut.
2. Continuously welded door and frame seals with no filler.
3. Remove weld spatter, oxides, and flux.
4. Grind exposed welds smooth.

G. Fabricate exposed faces of doors only from cold-rolled steel.

H. Fabricate frames from either cold-rolled or hot-rolled steel (at fabricator's option).

I. Unless otherwise indicated, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.

J. Shop Painting:
1. After fabrication, thoroughly clean surfaces of mill scale, rust, oil, grease, dirt, and other foreign matter, and chemically treat with phosphate compound so as to assure maximum paint adhesion.
2. After pre-treatment of galvanized metal, apply shop coat of specified primer of even consistency in order to provide a uniformly finished surface, ready to receive finish painting.
3. Finish shall comply with ANSI/SDI A250.10.
4. Provide different colored shop primer to differentiate galvanized from non-galvanized products when delivered to Project site.

2.5 STEEL FRAMES

A. Provide steel frames of the types and styles indicated on the Drawings.

B. Gages:
1. Interior:
a. Frames in Openings 4’-0" or Less in Width: 16 gage unless thicker gage is included in UL test procedure for rated frames.
b. Frames in Openings over 4’-0" Width: 14 gage.
2. Exterior: 14 gage.

C. Design and Construction – Standard Frames:
1. Typical: Factory-assembled and weld into a single unit by frame manufacturer. Saw-miter or cope and tab frame miters, and continuously weld at return, face, rabbet, and stop.
2. Knock-Down Type: “Timely Prefinished Steel Door Frames” by Timely Industries as specified, or accepted equal.
a. Styles:
1) Swing Doors: Timely “C” Series, kerfed profile to receive continuous sound gasket.
2) Pocket Doors: Timely “Pocket Door Trim Kit.”
b. Casing: Manufacturer’s standard cold-rolled steel with 1/4 inch reveal and corner alignment clips; TA-08, or equal.
c. Finish: Prefinished with factory-applied baked enamel in custom color to be selected by Architect. [Manufacturer’s standard two-coat primer. Frames shall be field finish painted as specified in Section 09 9000, “Painting and Coating.”]
d. Fabricate knocked down frames into three pieces for field assembly into a rigidly interlocked single unit with mitered corners.
3. Trimless: 20-gage, double rabbet profile, adjustable for wall thickness, with integral stop and reinforced perforated side strips to receive gypsum board taping and finishing; “EZY-Jamb” by Studco Building Systems US, LLC, or accepted equal.
a. Frame Finish: Prefinished with factory-applied baked enamel in custom color to be selected by Architect.
b. Hinges: Butt type, ball bearing, as provided by frame manufacturer for 1-3/4 inch doors.
1) Material and Finish: Stainless steel, satin.
2) Size and Quantity: In accordance with manufacturer’s sizing chart for weight and size of doors.

c. Prepare frames to receive door strike specified in Section 08 7100, “Door Hardware.”

4. Frames shall be custom made welded units with integral trim and backbends, of the sizes and shapes shown on approved shop drawings. Knocked-down frames will not be accepted.
5. Jamb depths, trim, profile and backbends shall be as shown on Drawings.
6. Corner joints shall have all contact edges closed tight, with trim faces mitered and continuously back welded, and stops mitered. Unless otherwise noted, the use of gussets will not be permitted.
7. Minimum depth of stops shall be 5/8 inch unless otherwise noted. Drill stops for silencers: three in strike stops for single swing doors, two in head stops for double swing doors.
8. Profile bottom of jamb to contour of concrete at change in floor elevation occurring within jamb width.
9. Floor Anchors:
   a. Floor anchors shall be securely welded inside each jamb for floor anchorage.
   b. Where required, provide adjustable floor anchors, providing not less than 2 inch height adjustment.
   c. Minimum thickness of floor anchors shall be 14 gage.
10. Jamb Anchors:
   a. Frames for installation in stud partitions shall be provided with steel anchors of suitable design, not less than 18 gage thickness, securely welded inside each jamb as follows:
      1) Frames up to 7 feet – 6 inches High: 4 anchors.
      2) Frames 7 feet – 6 inches to 8 feet – 0 inches High: 5 anchors.
      3) Frames over 8 feet – 0 inches High: 5 anchors plus one additional for each 2 feet or fraction thereof over 8 feet – 0 inches.
   b. Provide ceiling struts for fire rated frames where required by ANSI/UL 63.
11. Frames shall be provided with a steel spreader temporarily attached to the feet of both jambs to serve as a brace during shipping and handling.
12. Hollow metal frames at fire rated openings shall meet manufacturer's specifications for indicated level of fire rating.

D. Door Silencers and Seals:
1. Provide door silencers except on frames to receive seals provided under Section 08 71 00, “Door Hardware.”
2. Locate three on strike jamb for single doors and four on head for pairs of doors.

E. Exposed Fasteners: Unless otherwise indicated, provide countersunk, flat Phillips or Jackson heads for exposed screws and bolts.

2.6 HOLLOW METAL DOORS

A. ANSI/SDI Classification:
1. Exterior: Level 3 and Physical Performance Level A, Model 2, extra heavy-duty seamless construction.
   a. Face sheets shall be minimum 0.053 inches (16 gage).
   b. Insulated, steel stiffened, for a minimum "U" value of 0.24 except where opening into unconditioned spaces.
2. Interior Non-Fire-Rated: Level 3 and Performance Level A, Model 2, seamless construction.
   a. Face sheets shall be minimum 0.042 inches (18 gage).
   b. Core: Honeycomb or polystyrene, laminated to the inside of both face sheets.
3. Interior Fire-Rated: Level 3 and Performance Level A, Model 2, seamless construction.

a. Face sheets shall be minimum 0.042 inches 18 gage) unless otherwise required for required rating.
b. Core: Mineral fiber or as standard with manufacturer to meet scheduled fire rating.
c. Rating: As scheduled.

B. The top and bottom of out-swinging exterior doors shall be closed with either a flush or inverted channel cap, welded, filled, and finished smooth to provide protection from entry of water inside door.

C. Design and Construction: In addition to requirements of the specified ANSI/SDI Classification, doors shall comply with the following.
1. Doors shall be of the types and sizes shown on the approved shop drawings, and shall be fully welded seamless construction with no visible seams or joints on their faces or vertical edges.
2. Thickness: As scheduled.
3. Doors shall be strong, rigid and neat in appearance, free from warpage or buckles. Corner bends shall be true and straight and of minimum radius for the gage of metal used.
4. Face sheets shall be stiffened by continuous vertical formed steel sections spanning the full thickness of the interior space between door faces.
a. Stiffeners shall be not less than 22 gage spaced not more than 6 inches apart and securely attached to face sheets by spot welds not more than 5 inches on center.
b. Spaces between stiffeners shall be sound-deadened and thermal insulated the full height of the door with an inorganic non-combustible batt-type material.
5. Door faces shall be joined at their vertical edges by a continuous weld extending the full height of the door. Welds shall be ground, filled and dressed to make them invisible and provide a smooth flush surface.
6. The top and bottom of out-swinging exterior doors shall be closed with either a flush or inverted channel cap, welded, filled, and finished smooth to provide protection from entry of water inside door.
7. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.
8. Flatness: Doors shall maintain a flatness tolerance of 1/16 inch maximum, in any direction, including in a diagonal direction.
9. Edge profiles shall be provided on both vertical edges of doors as follows:
a. Single-acting swing doors: beveled 1/S" in 2 inches.
b. Double acting swing doors: rounded on 2-1/S" radius.

D. Provide door clearances in accordance with ANSI/SDI A250.8 except as required to coordinate with hardware specified in Section 08 71 00, “Door Hardware.”

2.7 DOOR ACCESSORIES

A. Non-Rated Louvers: Stationary non-vision, inverted-"Y" blade type, 1-inch thick; Model AFDL by Anemostat Door Products, or equal.
1. Materials: 22-gage steel blades and 18 gage frame, galvanized at exterior locations.
2. Provide with insect screen at exterior doors.
3. Fasteners shall be located on secure side of door.

B. Rated Louvers: Stationary non-vision blade type, 1-inch thick, with fusible link and operating lever; Model FLDL by Anemostat Door Products, or equal.
1. Materials: 18-gage steel blades and frame.

2. Fasteners shall be located on secure side of door.

2.8 FINISH HARDWARE PREPARATION

A. Comply with ANSI A115, where applicable, and SDI-107.

B. Provide minimum gage hardware reinforcing in accordance with Table 1 of ANSI A250.6 or Table IV of ANSI A250.8 and the following.
1. Doors shall be mortised, reinforced, drilled and tapped at the factory for fully templated hardware only in accord with the approved hardware schedule and templates provided by the hardware supplier. Where surface-mounted hardware (or hardware, the interrelation of which is to be adjusted upon installation - such as top and bottom pivots, floor closers, etc.) is to be applied, doors shall have reinforcing plates.
2. Minimum gages for hardware reinforcing plates shall be as follows:
a. Hinge and Pivot Reinforcement: 7 gage.
b. Reinforcement for Lock Face, Flush Bolts, Concealed Holders, Concealed or Surface Mounted Closers: 12 gage.
c. Reinforcements for All Other Surface Mounted Hardware: 16 gage.
3. Interior Hollow Metal frames at Fire Rated Openings: Meet manufacturer's specifications for indicated level of fire rating.

C. Drilling and tapping for surface-applied finish hardware shall be done at Project site by hardware installer.

D. Concealed Overhead Closers: Provide spaces, cutouts, reinforcing, and provisions for fastening in top rail of doors or head of frames as applicable.

E. Reinforce steel doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware shall be done at Project site by hardware installer.

F. Locate finish hardware as shown on final shop drawings or, if not shown, in accordance with NBHA publication "Recommended Location for Builder's Hardware."

G. Labeled Doors and Frames: Refer to Section 08 71 00, "Door Hardware" for mounting heights of hardware on doors and frames, unless otherwise noted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions where steel doors and frames are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION OF FRAMES

A. Install frames in accordance with ANSI/SDI A250.11 and the additional requirements of manufacturer for concealed jamb frames.

B. Exercise care in setting of frames in order to maintain scheduled dimensions, hold head level, and maintain jambs plumb and square.

C. Secure anchorages and connections to adjacent construction.
   1. Provide not less than three anchors and one floor clip per side for doors up to 7 feet high and four anchors and one floor clip per side for doors over 7 feet high.
   2. Frames over 36 inches wide shall have one anchor at head.
   3. Anchors shall be furnished to suit wall conditions and floor angles or clips welded to frame for fastening to floor.

D. Wherever possible, leave frame spreader bars intact until frames are set perfectly square and plumb and anchors are securely attached. Do not use shipping bars as spreaders.

E. Allow for expansion movement as required.

F. Install fire-rated frames in accordance with NFPA Standard No. 80.

G. Frames at sound-rated doors shall be filled with mineral wool insulation conforming to the requirements of Section 09 82 00, "Acoustic Insulation and Sealants."

3.3 INSTALLATION OF DOORS

A. Install steel doors in accordance with manufacturer's instructions and Project requirements.

B. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.

C. Do not erect members that are observed to be warped, bowed, deformed, or otherwise damaged or defaced to such extent as to impair strength or appearance. Remove and replace members that have been damaged in process of erection.

D. Apply hardware in accordance with requirements specified in Section 08 71 00 "Door Hardware."

E. Adjust operable parts for correct function.

3.4 ADJUST AND CLEAN

A. After erection, items with damaged prime coat shall be sanded smooth and touched up with same primer as applied at shop.
   1. Remove rust before touch-up is applied.
   2. Touch-up shall not be obvious after application of finish coats.

B. Check and readjust operating finish hardware items, leaving steel items undamaged and in complete and proper operating condition.

C. Hollow metal frames or doors which are defective, have hardware cutouts of improper size or location, or which prevent proper installation of doors, hardware or work of other trades, shall be removed and replaced with new at no additional cost to Owner.

3.5 PROTECTION

A. Protect installed work against damage from other construction work and until ready to receive final finish painting as specified in Section 09 90 00, "Painting and Coating."

END OF SECTION

SECTION 08 14 00

WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Wood flush doors.
2. Factory preparation for finish hardware.
3. Factory finishing.

B. Related Requirements:
1. Hollow Metal Doors and Frames: Section 08 11 13.
2. Door Hardware: Section 08 71 00.
3. Painting and Coating: Section 09 90 00; site finishing of doors.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action Submittals and Informational Submittals shall be submitted in accordance with Section 01 33 00, “Submittal Procedures.”
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures,” and Section 01 78 36, “Warranties.”

1.3 ACTION SUBMITTALS

A. Shop Drawings: Submit door schedule indicating the following:
1. Opening-identifying symbol. Use same identification as Door Schedule on Drawings.
2. Location and sizes of each door.
3. Door type and grade.
4. Elevation of each kind of door.
5. Swing.
6. Undercuts.
7. Louvers.
8. Location and extent of any required hardware blocking.

B. Product Data:
1. Manufacturer’s door specifications.
a. Indicate door core and edge materials and construction; veneer species, type, and characteristics; trim for openings and louvers; and factory finishing and machining criteria.
2. Shop-applied primer.

C. Samples: Door construction, 12 inches square minimum, cut from top or bottom corner of door to illustrate core and face veneer.

1.4 INFORMATIONAL SUBMITTALS

A. Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

B. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

A. Executed special warranty.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain wood doors from single manufacturer.

B. Quality Standard: In addition to requirements specified, doors shall be manufactured in accordance with Section 9 of the "North American Architectural Woodwork Standards (NAAWS)" published jointly by WI and AWMAC.

C. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

D. Allowable Tolerances for Fabrication of Doors: In accordance with referenced NAAWS standard.

E. Fire-Rated Assemblies: Wherever a fire-resistance classification is indicated, provide fire-rated doors investigated and tested as part of a fire door assembly, complete with type of fire door hardware to be used.
1. Identify each fire-rated door with a label from Underwriters Laboratories, Inc. (UL) or Intertek Testing Services-Warnock Hersey (ITS-WH) indicating applicable fire rating and other specified requirements. Labels shall be attached to door.

F. Construct fire-rated doors in accordance with NFPA Standard 252.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors at factory prior to shipping, using manufacturer’s standard method.

C. Seal all four edges of site-finished doors after delivery if stored for more than 1 week at the Project site.

D. Label and identify doors for each opening to facilitate proper location using temporary, removable, or concealed markings. Correlate door identification with designation system used on shop drawings.

E. Store doors flat on level surface in clean, dry, and properly ventilated spaces.
1. Do not expose doors to abnormal heat, dryness, and humidity.
2. Do not store in areas where sunlight might bleach veneer.

F. Comply with additional requirements specified in Section 01 60 00, "Product Requirements."

1.8 WARRANTY

A. Door Manufacturer's Warranty:
1. Submit written agreement on door manufacturer's standard form signed by manufacturer, installer, and Contractor, agreeing to repair or replace defective doors which warp (bow, cup, or twist), which show telegraphing of core construction in face veneers, or which do not conform to tolerance limitations of specified quality standards.

2. Include reinstallation if required owing to repair or replacement of defective doors where defect was not apparent prior to hanging.

B. Warranty Period:
1. Interior Hollow-Core Doors: 1 year.
2. Interior Solid-Core Doors: Lifetime of the original installation.
3. Interior Stile-and-Rail: 1 year.

C. Exterior Stile-and-Rail Doors: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Flush Wood Doors: “Aspiro Series” | Marshfield-Algoma by Masonite Architectural, V-T Industries, or equal member of WI, AWI or WDMA.

2.2 DESIGN AND PERFORMANCE CRITERIA

A. In addition to requirements specified, doors shall be manufactured in accordance with Section 9 of the "North American Architectural Woodwork Standards (NAAWS),” published jointly by WI, AWI, and AWMAC, and referenced WDMA Standards where noted.

B. Allowable Tolerances for Fabrication of Doors: In accordance with referenced NAAWS standard.

C. Fire-Rated Assemblies: Wherever a fire-resistance classification is indicated, provide fire-rated doors investigated and tested as part of a fire door assembly, complete with type of fire door hardware to be used
1. Identify each fire-rated door with a label from an approved laboratory indicating applicable fire rating and other specified requirements.
2. Construct fire-rated doors in accordance with NFPA Standard 252.

D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

2.3 FLUSH WOOD DOORS

A. Door Appearance Grade:
1. Opaque Finish: Custom.
2. Transparent Finish: Premium.

B. Face Veneer:
1. Doors to Receive Opaque Finish: Medium-density overlay (MDO).
2. Doors to Receive Transparent Finish: Hardwood veneer.
a. Species and Cut: To be finalized by Architect.

C. Cross Banding: Hardwood veneer, 1/16 inch thick.

D. Cores:
1. Typical: Solid, 5-ply, type optional with manufacturer in accordance with WDMA Standard I.S. 1A.

2. Provide mineral core at fire-rated doors if required to meet fire rating.

E. Edge Construction:
1. General:
a. Securely glue edge-bands to core. Top and bottom bands may be secured in place with machine joint.
b. Doweling of vertical to horizontal edge-bands for oversize doors is permitted.
2. Vertical: NAAWS Type D; full length hardwood, 3/4-inch thick minimum after trimming, Structural Composite Lumber (SCL) backer, with cross band edges covered.
3. Horizontal: SCL, 1-1/4-inch thick minimum after trimming.

F. Thickness: 1-3/4 inch, unless otherwise noted.

2.4 DOOR FABRICATION

A. Conform to requirements of regulatory agencies, reference standards, reviewed shop drawings, and Contract Documents.

B. Performance Duty Levels (WDMA):
1. Typical: Heavy Duty.
2. Restroom and Other High Use Openings: Extra Heavy Duty.

C. Factory-cut openings, insofar as practicable.

D. Prefit and premachine doors.
1. Coordinate preparation of doors with hardware requirements specified in 08 7100 “Door Hardware.”
2. Comply with the tolerance requirements of NAAWS or WDMA for prefitting.

E. Undercut doors where indicated.

F. Seal raw edges immediately after cutting and fitting, including areas routed for hardware.

G. Provide door clearances in accordance with the WDMA Standard and as follows.
1. For non-rated doors provide clearances of 1/8 inch at jambs and heads, and 1/4 inch from bottom of door to top of floor finish, unless otherwise indicated on Drawings.
2. When threshold is shown or scheduled, provide 1/8 inch clearance from bottom of door to top of threshold.
3. Modify clearances as required for specified seals.

2.5 ADDITIONAL REQUIREMENTS FOR FIRE-RATED DOORS

A. General:
1. Provide mineral core if required to meet scheduled fire rating.
2. Doors shall be properly labeled to match their listing properties.
3. Factory fit and machine doors for frame and finish-hardware in accordance with NFPA 80 requirements and dimensions. Do not machine for surface hardware. Apply appropriate fire labels.
4. Edges shall have improved screw holding capability and split resistance.
5. Provide minimum 5-1/2 inch wide by suitably sized lengths of solid wood inner blocking at all hardware locations in mineral core, labeled doors that are to receive surface mounted hardware, or mortised or bored locksets and exit devices. Through bolts are not permitted.

B. 20-minute Rated Doors:
   1. Pairs shall be rated without requirement for metal edges or astragals.
   2. As required by manufacturer to permit positive pressure “S” label per Category H.
   3. Vertical edges (stiles) matching face veneers shall be fire treated if required for fire rating.

C. Mineral Core Doors:
   1. Stiles shall be manufacturer’s standard edge for improved screw holding (Neutral Pressure) and as required by manufacturer to meet Positive Pressure Category A (concealed intumescent).

2.6 FINISHING

A. General: Finishing shall conform to NAAWS “Premium” Grade requirements with shop applied coatings applied in accordance with manufacturer's written instructions.

B. Opaque Finish: Factory primed and shop or field finish painted as specified in Section 09 90 00, “Painting and Coating.”

C. Transparent Finish: Catalyzed polyurethane complying with NAAWS System – 11 or WDMA System TR-6.
   1. Gloss Level: To match approved sample.
   2. Provide factory finishing only; field finishing will not be permitted.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that doorframes are of type required for door and are installed as required for proper installation of doors.

B. Do not install doors in frames which would hinder door operation.

C. Condition doors to average prevailing humidity in installation area prior to hanging.

3.2 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and requirements of NAAWS or WDMA Standards.

B. Door Bevel:
   1. Nonrated Doors: Bevel 1/8 inch in 2 inches.
   2. Rated Doors: Bevel as permitted by labeling agency.

C. Install fire-rated doors in fire-rated frames in accordance with requirements of National Fire Protection Association (NFPA) Standard No. 80 and fire rated labeling requirements.
   1. Trim bottom edge of fire doors in accordance with fire rating requirements.
   2. Do not trim positive pressure rated doors for width.

D. Fit to frames and machine for hardware to whatever extent not previously worked at factory as required for proper fit and uniform clearance at each edge.

3.3 ADJUST AND CLEAN

A. Replace or rehang doors which are hinge bound and do not swing or operate freely.

B. Protect installed wood doors from damage or deterioration until acceptance of work.

C. Refinish or replace finished doors damaged during installation as directed by the Architect.

END OF SECTION

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Access doors in walls and ceilings.

B. Related Requirements:
   1. Gypsum Board: Section 09 29 00.
   2. Paints and Coatings: Section 09 90 00.
   3. Plumbing: Division 22.
   4. Heating, Ventilating, and Air-Conditioning: Division 23.
   5. Electrical: Division 26.

C. Coordination: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment; coordinate installation with work of other trades.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
   1. Action Submittals and Informational Submittals shall be submitted in accordance with Section 01 33 00, “Submittal Procedures.”

B. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures,” and Section 01 78 36, “Warranties.”

1.3 ACTION SUBMITTALS

A. Shop Drawings: Indicate locations of required access doors not shown on the Drawings.

B. Product Data: Manufacturer's drawings and printed literature, indicating method of construction, joinery, finishes, size, shape, thickness, and alloy of materials and relationship to adjacent work.
   1. Manufacturer's Installation Instructions: Indicate special installation criteria, interface with adjacent components.
   2. Manufacturer’s test reports for rated products certifying compliance with required fire tests for UL label.

1.4 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Where required, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in UL "Classified Building Materials Index" for the rating indicated. Provide UL label on each access door.

B. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes shown, scheduled, or specified in Divisions 22, 23, 26, 27 and 28.

C. Mockups:
1. First installed example of each type of floor access door, with finish flooring installed, shall serve as a mockup for review by Architect of workmanship, visual effect, and interface with adjacent construction. Coordinate with installers of finish flooring.
2. In addition, if requested by Architect, first installed examples of other types of access doors shall serve as mockups.
3. In addition, if requested by Architect, first installed examples of other types of access doors shall serve as mockups.
4. Comply with additional requirements of Section 01 43 39, “Mockup Requirements.”

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with additional requirements specified in Section 01 60 00, “Material and Equipment.”

1.6 GUARANTEE

A. Contractor: In addition to its standard guarantee under the Contract, furnish to Owner a written guarantee for fire-rated floor doors against all defects in materials and workmanship for 5-years from date of acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Metal Access Doors for Walls and Ceilings: Karp Associates Inc. as specified and the basis of design, Milcor Inc., J. L. Industries, Jay R. Smith Manufacturing, or equal.

2.2 DESIGN AND PERFORMANCE CRITERIA

A. Fire-Resistance Ratings: Where required, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in UL "Classified Building Materials Index" for the rating indicated. Provide UL label on each access door.

B. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes shown, scheduled, or specified in Divisions 22, 23, 26 and 28.

C. Provided doors and panels with and without lock functions, in locations indicated and to be confirmed by Owner.

2.3 INTERIOR ACCESS DOORS

A. General:
1. Provide attachment devices and fasteners of type required for specific project conditions.
2. At sound-rated conditions use "fire-rated"-type doors.
3. Products specified in Division 22, 23, 26, 27 and 28 that meet the requirements of this Section are acceptable.

B. Gypsum Board Partitions – Non-rated: Karp Model KDW.
1. Style: Flanged type for flush mounting with concealed frames.
2. Frame: 16-gage galvanized steel, except as otherwise specified.
3. Door: Not lighter than 14-gage galvanized steel, except as otherwise specified.

4. Hinges: Continuous piano type or concealed spring, allowing opening to 175 degrees.

C. Gypsum Board Partitions – Non-rated, Tile or FRP Paneling: Stainless steel; Karp Model DSC-214M, or equal.
1. Trim Style: 3/4-inch wide, flush flange.
2. Frame: 16 gage.
3. Door: Not lighter than 14-gage.
4. Hinges: Continuous piano type or concealed spring, allowing opening to 175 degrees.

D. Gypsum Board Partitions and Ceilings - Rated: Model KRP-350FR and KRP-450FR.
1. Type: Manufacturer's fire-rated access doors with UL "B" Label.
2. Style: Textured 1-inch frame and bead to receive drywall joint compound installed in sufficient thickness to conceal flange.
3. Frame: 16-gage galvanized steel.
4. Door: 20-gage galvanized steel, insulated sandwich type at ceilings, self-latching.
5. Hinges: Allow opening to 175 degrees, self-closing.

E. Gypsum Board Partition - Rated, Tile or FRP Paneling: Stainless steel; Model KRP-250FR.
1. Type: Manufacturer's fire-rated access doors with UL "B" Label.
2. Style: 1-inch wide trim with welded corners, ground smooth.
3. Frame: 16 gage.
4. Door: 16 gage.
5. Hinges: Allow opening to 175 degrees, self-closing.

F. Locking Devices:
1. Typical Areas: Allen key or screwdriver-operated latch.
2. Areas Accessible to Public or Determined by Owner as Requiring Locking: Key-operated cylinder lock.
a. Provide two keys per lock and key locks alike, unless otherwise scheduled or directed by the Architect.
b. For locks on panels 24 inches in any dimension, provide interior latch mechanism to allow door to be opened from the inside without a key.
c. Coordinate keying with Section 08 71 00, “Door Hardware.”

G. Finishes:
1. Typical: Factory-applied rust-resistant prime coat. Doors shall be field finish painted to match adjacent wall finish.
2. At Tile and FRP Paneling: Stainless steel, AISI No. 4 satin finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment; coordinate installation with work of other trades.

3.2 INSTALLATION

A. General:
1. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces in accordance with manufacturer's instructions for installation.

2. Install fire-rated doors in accordance with NFPA 80.

B. Access Doors and Panels:
1. Install in locations required to give access to plumbing, mechanical, electrical, or similar devices concealed in walls or ceilings, whether or not specifically indicated on the Drawings.
2. Conceal frames with tape and joint compound at painted gypsum board partitions as specified in Section 09 29 00, “Gypsum Board.”

C. Floor Doors:
1. Refer to Drawings for location of access panel and each floor access door.
2. Follow manufacturer’s instructions for installing floor doors to maintain specified fire rating at rated doors.
3. Install frames plumb and level in opening, in proper alignment with floor surface for flush installation of cover with adjacent finish floor. Secure rigidly in place.

D. Adjust hardware and doors after installation for proper operation.

3.3 PROTECTION

A. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

Section 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY: Provide Door Hardware, as shown and specified per Contract Documents.
1.2 REFERENCES:
A. Americans with Disabilities Act (ADA):
1. General: Americans with Disabilities Act of 1990, ADA - 42 U.S. Code Chapter 126.
2. ADA Standards for Accessible Design: U.S. Department of Justice, 28 CFR Part 36.
B. American National Standards Institute (ANSI): ANSI A117.1 and the California Code of Regulations, Title 24.
C. American Society for Testing and Materials (ASTM): Materials and testing standards as identified throughout this Section or within referenced manufacturers standard specifications.
D. Architectural Woodwork Institute (AWI): Quality standards.
E. Builders Hardware Manufacturers Association (BHMA): Hardware standards.
F. California Building Code (CBC): Hardware standards.
G. Door and Hardware Institute (DHI): Hardware installation standards.
H. National Fire Protection Association (NFPA): NFPA 252.
I. Underwriters Laboratories, Inc. (UL):
1. UL 305: Panic Hardware.
J. Woodwork Institute (WI): Manual of Millwork.
1.3 SUBMITTALS:
A. General:
1. General: Submit product data, test reports, certificates and as follows:
2. Shop Drawings:
a. General: Submit detailed finish hardware schedule in vertical format as follows:
b. List groups and suffixes in proper sequence.
c. Completely describe door and list architectural door number.
d. Provide name of manufacturer, product name, catalog number, function, type, style, size and finish of each item.
e. Show mounting locations.
f. Explain abbreviations and symbols used in schedule.
g. Provide detailed wiring diagrams, specially developed for each applicable opening, indicating all electric hardware, security equipment, and access control equipment, and door and frame rough-ins required for specific opening.
3. Samples:
a. General: If specifically requested for specified products; required for alternate products.
b. Substitutions Requests: Refer to Section 01 25 00 - SUBSTITUTION PROCEDURES. Submit schedule and sample of each item proposed for substitution. Clearly mark each sample indicating type of item, manufacturer's name, catalog number and item for which it is proposed to be substituted.
c. Disposition: Accepted samples may be used in work; rejected samples will be returned.
B. Closeout:
1. Maintenance Data: Provide manufacturer's instructions and special maintenance tools and accessories as required. Provide three copies of the lock service manual.
2. Guarantee:
a. General: Provide in required form for a period of one (1) year from date of final acceptance by Owner and as follows:
b. Manufacturer’s Warranty:
1. Door Closers: Ten (10) years.
2. Exit Devices: Three (3) years.
3. Locksets and Cylinders: Three (3) years.
4. All Other Hardware: Two (2) years.
1.4 QUALITY ASSURANCE:
A. Manufacturers: Specializing in production of institutional and commercial door hardware for a minimum of five (5) years.
B. Supplier:
1. General: A firm specializing in the supply and servicing of institutional and commercial door hardware for at least five (5) years.

2. Personnel: Employ an Architectural Hardware Consultant (AHC or DAHC), accredited by the Door and Hardware Institute (DHI), to supervise detailing and supply of material for the Project. If requested, inspect final installation and report problems and suggested corrective measures to the Architect.

C. Coordination:
1. General: Apply hardware to aluminum or metal doors and frames, and factory prepared wood doors and frames, to template; provide two (2) copies of accepted Finish Hardware Schedule for use by door and frame suppliers.
2. Distribution: Furnish two (2) copies of each template to manufacturers who are not listed as current template book holders; furnish two (2) copies of each template for items whose manufacturers do not provide registered template book.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Acceptable Manufacturers:

ITEM	1	2	3
Hinges	Hager	McKinney	Lawrence
Locks	Hager	Schlage	Best
MagLock	Securitron	(No Substitution)	
Cylinders	Hager	Schlage	Best
Exit Devices	Sargent	Von Duprin	Precision
Closers	Hager	LCN	Sargent
Coordinators	Hager	Rockwood	Trimco
Flush Bolts	Hager	Rockwood	DCI
Push/Pulls	Hager	Rockwood	Trimco
Kickplates	Hager	Rockwood	Trimco
Stops	Hager	Rockwood	Trimco
Weatherstripping	Hager	Pemko	Reese
Door Gasketing	Hager	Pemko	Reese
Threshold	Hager	Pemko	Reese

2.2 HINGES:

A. Hinges, and electric hinges shall be of one manufacturer as listed for continuity and consideration of warranty.

B. Standards: Manufacturer to be certified by the following:
1. Hinges and Pivots: ANSI/BHMA A156.1
2. Template Hinge Dimensions: ANSI/BHMA A156.7
3. Finishes: ANSI/BHMA A156.18

C. Butt Hinges:
1. Hinge weight and size unless otherwise indicated in hardware sets:
a. Doors up to 36 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of .180 inch at exterior doors, and paired doors, .134 inch at interior doors and a minimum of 4-1/2 inches in height.
b. Doors from 36 inches wide up to 42 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of .190 inch and a minimum of 5 inches in height.
c. For doors from 42 inches wide up to 48 inches wide and up to 1-3/4 inches thick provide hinges with a minimum thickness of .190 inch and a minimum of 5 inches in height.
d. Doors greater than 1-3/4 inches thick provide hinges with a minimum thickness of .190 inch and a minimum of 5 inches in height.
e. Width of hinge is to be minimum required to clear surrounding trim.
2. Base material unless otherwise indicated in hardware sets:
a. Exterior Doors: 304 Stainless Steel material.
b. Interior Doors: Steel material.
c. Fire Rated Doors: Steel or 304 Stainless Steel materials.
3. Quantity of hinges per door:
a. Doors up to 60 inches in height shall have 2 hinges.
b. Doors 60 inches up to 90 inches in height shall have 3 hinges.
c. Doors 90 inches up to 120 inches in height shall have 4 hinges.
d. Doors over 120 inches in height add 1 additional hinge per each additional 30” in height.

4. Hinge design and options unless otherwise indicated in hardware sets:
   a. Hinges are to be of a square corner five knuckle design, flat button tips and have ball bearings unless otherwise indicated in hardware sets.
   b. Out-swinging exterior and out-swinging access controlled doors shall have non-removable pins (NRP) to prevent removal of pin while door is in closed position.
   c. When full width of opening is required, use hinges that are designed to swing door completely from opening when door is opened to 95 degrees.
   d. Electric Through Wire (ETW) to have appropriate number of wires to transfer power through door frame to door for proper connection of finish hardware and certified to handle an amperage rating of 3.5 AMPS/continuous duty with 16.0 AMPS/intermittent duty.
   e. Provide mortar boxes for frames that require any electrically modified hinges if not an integral part of frame.
   f. When shims are necessary to correct frame or door irregularities, provide metal shims only.

2.3 MORTISE LOCKS AND LATCHES:

A. Locks and latches shall be of one manufacturer as listed for continuity of design and consideration of warranty.
B. Standards: Manufacturer to be certified and or listed by the following:
   1. ANSI/BHMA A156.13 Series 1000 Certified to Grade 1 for Operational and Security.
   2. UL/cUL Labeled and listed for functions up to 3 hours for single doors up to 48 inches in width and up to 96 inches in height.
   3. ANSI/UL10C/UBC 7-2 Positive Pressure Rated.
   4. ICC/ANSI A117.1.
C. Lock and Latch function numbers and descriptions of manufacturer's series as listed in hardware sets.
D. Material and Design:
   1. Lock cases from fully wrapped, 12 gage steel, zinc dichromate for corrosion resistance.
   2. Non-handed, field reversible without opening lock case.
   3. Break away spindles to prevent unlocking during forced entry or vandalism.
   4. Levers are to be zinc cast, forged brass or stainless steel and plated to match finish designation in hardware sets.
   5. Escutcheons are to be of solid brass or stainless steel material.
   6. Armor fronts are to be self adjusting to accommodate a square edge door or a standard 1/8" beveled edge door.
E. Latch and Strike:
   1. Stainless steel latch bolt with minimum of ¾" throw and deadlocking for keyed and exterior functions.
   2. Strike is to fit a standard ANSI A115 prep measuring 1-1/4 inches x 4-7/8 inches with proper lip length to protect surrounding trim.
   3. Deadbolts to be 1-3/4 inches total length with a minimum of a 1 inch throw and ¾ inch internal engagement when fully extended and made of stainless steel material.

2.4 EXIT DEVICES:

A. Shall be touch pad type, finish to match balance of door hardware. Exit devices shall be of one manufacturer as listed for continuity of design and consideration of warranty.
B. Standards: Manufacturer to be certified by the following:
   1. Exit Devices: ANSI/BHMA A156.3 Grade 1
   2. UL labeled panic exit hardware
   3. UL labeled fire exit hardware
C. Touch pad shall extend a minimum of one half door width. Lever design shall match design of locks levers. Exit device to mount flush with door.
D. Components:
   1. Covers and end caps shall be brass, bronze, or stainless steel.
   2. Chassis shall be cold forged steel.
E. Lock and Latch Functions: Function numbers and descriptions of manufacturer's series and lever styles indicated in door hardware sets.
F. Mounting:
   1. 4-1/2 inch minimum stile width required for double doors with concealed vertical rod devices.
   2. 4-1/2 inch minimum stile width required for single door.
   3. 4-1/2 inch minimum stile width required for double door with rim devices.

G. Fasteners:
1. Wood and machine screws, as required. The use of thru-bolts is not allowed. Mount exit devices to doors which provide the required blocking and reinforcement necessary for installation without the use of thru-bolts.

2.5 CYLINDERS AND KEYING:
A. Cylinders shall be of one manufacturer as listed for continuity of design and consideration of warranty.
B. Standards: DHI Handbook - TDH 004: “Keying systems and nomenclature”.
C. Cylinders:
1. Manufacturer’s standard tumbler type, seven pin interchangeable core.
2. Shall be furnished with cams/tailpieces as required for the locking device that is being furnished for the project.
D. Keying:
1. Contact Owner with representative from hardware supplier to establish a keying conference. Verify keyway, visual key identification, number of master keys and keys per lock. Provide keying system per Owner’s instructions.
2. Copy of Owner’s approved keying schedule shall be submitted to Owner and Architect with documentation of when the keying conference was held and the Owner’s sign-off.
3. Provide a bitting list to the Owner of all combinations as established, and expand to twenty five percent for future use or as directed by Owner.
4. Key into Owner’s existing keying system, if applicable.
5. Provide interchangeable cores with construction cores as required.
6. Keys to be shipped to Owner’s representative; individually tag per the keying conference.
7. Provide visual key control identification on keys.
8. Key control system: include two set of key tags, hooks, labels, and envelopes. Contain system in metal cabinet with baked enamel finish, surfaced mounted to wall. Capacity shall be able to hold actual quantities of keys, plus 25 percent.

2.6 CLOSERS:
A. Shall be the product of one manufacturer. Unless otherwise indicated on hardware schedule, comply with manufacturer’s recommendations for size of closer, depending on width of door, frequency of use, atmospheric pressure, ADAAG requirements.
B. Standards: Manufacturer to be certified by the following:
1. Closers ANSI/BHMA A156.4 Grade 1
2. ADAAG
3. ICC/ANSI A117.1
C. Provide cast iron non-handed bodies with full plastic covers. Closer shall have separate staked adjustable value screws for latch speed, sweep speed, and backcheck, delayed action valve optional. Provide Tri-Pack arms and brackets for regular arm, top jamb, and parallel arm mounting for each closer.
D. Components:
1. One piece seamless steel spring tube to seal in hydraulic fluid.
2. Double heat treated steel tempered springs.
3. Precision machined heat treated steel piston.
4. Triple heat treated steel spindle.
5. Full rack and pinion operation.
E. Mounting:
1. Outswing doors shall have surface parallel arm mount closers except where noted on hardware schedule.
2. Inswing doors shall have surface regular arm mount closers except where noted on hardware schedule.
3. Provide brackets and shoe supports for aluminum doors and frames to mount fifth screw.
4. Furnish drop plates where top rail conditions on door do not allow for mounting of closer and where backside of closer is exposed through glass.
F. Fasteners: Provide self reaming and self-tapping wood and machine screws. The use of sex nuts and bolts is not allowed.
G. Pull effort on doors with closers to be maximum of 5 lbs. at interior doors and 5 lbs at exterior doors. The authority having jurisdiction may increase the maximum effort to operate the doors to

achieve positive latching, but not to exceed 15 lbs., per CBC 11B-404.2.9. Doors shall also comply with CBC 11B-404.2.8.1, closer delay time.

2.7 FLUSH BOLTS AND COORDINATORS:

A. Where flush bolts occur in Path of travel, provide automatic flush bolts to comply with CBC 11B-404.2.7. Automatic flush bolts shall meet ANSI/BHMA A156.3.
B. Non-labeled openings: Provide two flush bolts for inactive leaf of pairs of doors per hardware schedule. Top bolt shall not be more than 78 inches centerline from floor. Provide dust proof strike for bottom bolt.
C. Coordinators: Provide for labeled pairs of doors with automatic flush bolts. Provide filler piece to extend full width of stop on frame. Provide mounting brackets and special preparation for latches where applicable.
D. Manual flush bolts shall meet ANSI/BHMA A156.16 requirements. Manual flush bolts are used only where doors are not used by persons in wheelchairs.

2.8 PUSH PLATES AND PULL PLATES:

A. Push plates: .050 inch thick, square corner and beveled edges with counter sunk screw holes. Width and height as stated in Hardware schedule.
B. Pull plates: .050 inch thick, square corner and beveled edges. Width and height as stated in door schedule, ¾ inch diameter pull, with clearance of 2-1/2 inches from face of door.
C. Standards: Manufacturer to be certified by the following:
    1. Architectural Door Trim: ANSI/BHMA A156.6.
    2. Americans with Disabilities Act Accessibility Guidelines (ADAAG).

2.9 PROTECTIVE TRIM:

A. For single doors, size two inches less door width (LDW) on push side of door, and one inch less on pull side of door by 10 inches high. For pairs of doors, size one inch less door width (LDW) on push side of door, and ½ inch on pull side of door by 10 inches high.
B. Standards: Manufacturer to be certified by the following:
    1. Architectural Door Trim: ANSI/BHMA A156.6.
    2. UL
C. Kick plates shall be 0.050 inch thick stainless steel.
D. Fasteners: Supply #6 x 5/8 inch truss head screws, unless otherwise noted.

2.10 STOPS AND HOLDERS:

A. Provide door stops wherever necessary to prevent door or hardware from striking an adjacent partition or obstruction. Provide wall stops wherever possible. Door stops and holders mounted in concrete floor or masonry walls shall have stainless steel machine screws and lead expansion shields. Floor stops shall be mounted maximum 4 inches out from walls.
B. Standards: Manufacturer to be certified by the following:
    1. Stops and Bumpers: ANSI/BHMA A156.16.
    2. Overhead Stops and Holders: ANSI/BHMA A156.8.
C. Where wall stops are not appropriate, provide overhead stops or holders. Floor stops should only be used as the last means of stopping door. Do not mount floor stops where they will impede traffic.
D. Overhead stops and holders: Provide overhead stop and holders for doors that open against equipment, casework, sidelights, and other objects that would make wall stops/holders and floor stops/holders inappropriate per the hardware schedule.

2.11 DOOR GASKETING AND WEATHERSTRIP:

A. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing where indicated on hardware schedule. Provide non-corrosive fasteners for exterior applications.
    1. Perimeter gasketing: Apply to head and jamb, forming seal between door and frame.

2. Meeting stile gasketing: Fasten to meeting stiles, forming seal when doors are in closed position.
3. Door bottoms: Apply to bottom of door, forming seal with threshold or floor when door is in closed position.
4. Sound Gasketing: Cutting or notching for stop mounted hardware not permitted.

B. Standards: Manufacturer to be certified by the following:
1. Door Gasketing and Edge Seal Systems: ANSI/BHMA A156.22.

2.12 THRESHOLDS:
A. Secured with lead expansion shields and stainless steel machine screws. Notched in field to fit frame by hardware installer. Refer to Drawings for special details.
B. Thresholds shall meet BHMA A156.21 requirements, and conform to CBC.

2.13 SILENCERS: Where smoke, light, or weather seal are not required, provide three silencers per single door frame, two per double door frame.

2.14 POWER SUPPLY:
A. Security Contractor to provide and coordinate use of power supplies with door and frame locations.
B. Power Supplies, relays and battery backup units are to be provided as part of the overall system in accordance with the manufacturers warranty and system requirements.
C. UL listed for applicable use; housed in an approved enclosure; and provide Class 1 output.
D. Output shall be filtered and regulated. Relay, timer, and logic modules shall be as required for interface to indicated security components; and shall be assembled, connected, and fully contained within the power supply enclosure.
E. Provide required connections to the Fire Alarm / Life Safety System and for remote site activation of all electrified components and functions.
F. Provide the quantity of power supplies required per the system load requirements, plus 25%.
G. Coordinate the location of the power supplies with the Electrical Contractor, as directed by the Architect.

2.15 FINISHES:
A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if within range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples.
B. Comply with the base material and finish requirements indicated by BHMA designations in the hardware schedule on Architectural drawing A2.1 Floor Plans

PART 3 - EXECUTION

3.1 PREPARATION:
A. Examination: Examine conditions of work in place before beginning work; report defects.
B. Measurements: Take field measurements; report variance between plan and field dimensions.
C. Delivery:
1. Packaging: Identify door number, hardware type, location and hand of door on each package.
2. Keys: Label and deliver keys by registered mail or personal messenger directly to Architect.

3.2 APPLICATION:
A. General: Install in strict conformance with referenced standards, the manufacturer's written directions, as shown, and as herein specified.
B. Hardware Placement:
1. General: Except for hinges, do not install hardware until completion of painting and finishing work. Unless otherwise shown, place hardware at following height above finish floor:
2. Strike (Centerline) for Locks and Latches: Between 40 inches and 42 inches.
3. Hinges: Manufacturer's standard.
4. Door Pull (Centerline): 42 inches.
5. Push Plate (Centerline): 44 inches.

C. Floor Clearances:
   1. No Threshold: 3/4 inch maximum for metal doors; 5/8 inch maximum for wood doors.
   2. Threshold: 1/8 inch typical.
D. Installation:
   1. General: Install hardware in precise manner; door clearance and hardware placement as specified. Predrill pilot holes in wood for screws. Drill and tap for surface mounted hardware on metal.
   2. Hinges: Set hinge leaves snug and flat in mortises; turn screws to flat seat (do not drive). Drive hinge pins down and tighten set screws.
   3. Closers: Mount door closers for maximum swing of door before setting stops.
   4. Silencers: Set in place before adjusting strikes.
   5. Locksets: Install locks with keyways in proper position; levers, roses and escutcheons firmly attached.
   6. Thresholds: Set in waterproof sealant; secure with lead shields and countersunk screws of same finish as threshold.

3.3 ADJUSTMENT AND MAINTENANCE:
A. General: Prior to acceptance, adjust moveable parts to assure smooth operation.
B. Door Closers: Adjust for closing speed, latching speed, back checking, and hold-open devices for full control of door. Adjust operation of doors to require a maximum of 5.0 lbs. for exterior doors; 5.0 lbs. for interior doors; and 15 lbs. for fire doors.

3.4 HARDWARE GROUPS: As shown on Architectural drawing Sheet A-2.0 - Floor Plan.

END OF SECTION – 08-71-00

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Requirements for glass, and factory and field glazing of doors, storefronts, window, and curtain walls.
2. Unframed mirrors.

1.2 ACTION SUBMITTALS

A. Shop Drawings: As specified in related sections for systems in which glazing is installed.

B. Product Data: Manufacturer's literature substantiating that glass and glazing materials comply with specified requirements.

C. Delegated Design: Calculations for exterior glass to demonstrate compliance with applicable codes and specified structural and deflection requirements. Calculations shall be signed and sealed by the engineer in responsible charge retained by the Contractor. Engineer shall be a California licensed civil or structural engineer.

D. Samples: 12 inches square, of each type specified, except clear single-pane units.

1.3 INFORMATIONAL SUBMITTALS

A. Statement of fabricator/installer qualifications for exterior glazing.

B. Statement of qualifications for applicator of applied film.

1.4 QUALITY ASSURANCE

A. Where safety glass is indicated or required, provide type of products indicated which comply with ANSI Z97.1 and testing requirements of the U.S. Consumer Product Safety Commission "Safety Standard for Architectural Glazing Materials" 16 CFR Part 1201 for Category I materials.

B. Insulating Glass: Certified under IGMA-approved program and meeting CBA Grade requirement when tested in accordance with ASTM E773 and ASTM E774.

C. Mirrors shall meet CPSC or ANSI safety glazing requirements and shall be certified by the Safety Glazing Certification Council (SGCC).

D. Industry Standards:
1. Insulating glass shall be certified under a certification program approved by the Insulating Glass Manufacturers Alliance (IGMA).
2. Comply with GANA "Glazing Manual," except where more stringent requirements are indicated.

3. Comply with applicable provisions of the AAMA "Metal Curtain Wall, Window, Store Front and Entrance Guide Specifications Manual."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver glass with manufacturer's label indicating type, quality, and thickness on each piece.

B. Protect glass and glazing materials during delivery, storage, and handling so as to comply with manufacturer's directions and as required to prevent face and edge damage to glass and damage to glass and glazing materials from effects of moisture, including condensation and other causes.

C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.6 WARRANTY

A. Insulating Glass: 10 years.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Regulatory Requirements:
1. Comply with CBC Chapter 24, Section 2406.
2. Where safety glass is indicated or required, provide type of products indicated that comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category I or II materials, as applicable.
3. Mirrors shall meet CPSC or ANSI safety glazing requirements and shall be certified by the Safety Glazing Certification Council (SGCC).

B. Industry Standards:
1. Comply with applicable provisions of the AAMA "Metal Curtain Wall, Window, Store Front and Entrance Guide Specifications Manual."

C. Insulating glass to be certified under IGMA-approved program and meet Test Class CBA requirements when tested in accordance with ASTM E773 and ASTM E774.

2.2 GLASS MATERIALS

A. Annealed Float Glass: ASTM C1036, Type I, Class 1, Quality q3 or better.

B. Spectrally Selective Glass: Clear float and tempered glass as specified above with a spectrally selective Low-E coating that will provide highest visible transmittance, lowest shading coefficient, and high UV radiation blockage; "Sungate 100 Selective Low-E" by PPG Industries, "LoĒ2 272” by Cardinal Glass Industries, or accepted equal.

C. Insulating Glass: Certified under IGMA-approved program and meeting Test Class CBA requirements when tested in accordance with ASTM E773 and ASTM E774.
1. Units shall be fabricated from float glass as specified herein.
2. Provide tempered glass for both lights of glass where indicated or required by code.
3. Exterior Light: 1/4 inch thick, heat strengthened, PPG "Solargray".

4. Air Space: 1/2 inch with warm-edge spacer; “Cardinal “XL Edge,” PPG “Intercept,” or equal.
5. Interior Light: 1/4 inch thick, heat strengthened, PPG "Clear".

2.3 GLASS TYPES

A. GL-1: Clear, float, 1/4 inch (6mm) thick unless otherwise noted or specified, tempered where noted and required by code.

B. GL-2: Insulating Glass.

C. GL-3: Mirror Glass; ASTM C1503, Select quality, 6.0 mm thick.
1. Provide silver coating, copper-protective coating, and 1-mil-thick mirror backing paint.
2. Comply with CS 27.

2.4 FABRICATION

A. Glazing framing dimensions shall provide for necessary minimum bite on glass, minimum edge clearance, and adequate sealant thicknesses, with reasonable tolerances. Provide correct glass size for each opening, within tolerances and necessary dimensions established.

B. Factory-label each pane of glass. Do not remove labels until final acceptance is obtained.

C. Tempered glass shall be horizontally tempered with roller ripples in horizontal direction.
1. Where required, include an inconspicuous but visible permanent identifying label on each pane in accordance with ANSI Z97.1.
   a. Fused to glass.
   b. Include manufacturer's name or trademark, glass type, thickness, and designation of treatment.
   c. Label shall be upright and located in a lower corner.
2. Maximum warpage in accordance with industry standards.
3. Provide fireman's tempered-glass marker where required by the WFD.
4. Provide cutouts for fittings and hardware where indicated.

D. Edge Treatment at Butt-joint Glazing and Exposed Edges: Flat ground with a 1/16-inch ground 45-degree seam and polished, unless otherwise indicated on the Drawings.

E. Dimensional Tolerances: Glass shall comply with referenced standards, except for the following:
1. Edge bow in open- or closed-joint, butt-glazed situation shall not cause misalignment of adjacent panels in excess of 1/8 inch.
2. Width of joint dimension shall not vary within any butt joint by more than 1/16 inch.
3. Width of joint dimension shall not vary from nominal dimension by more than 1/16 inch.

F. Insulating Glass: Meet Class CBA requirements when tested in accordance with ASTM E773 and ASTM E774.
1. Units shall be fabricated from glass plies as scheduled for each glass Type.
2.

PART 3 - EXECUTION

3.1 GLAZING

A. Comply with combined printed recommendations of glass manufacturers and manufacturers of sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.

B. Tempered Glass: Provide at locations where noted, scheduled, and required in accordance with regulatory requirements.

C. Protect glass from edge damage during handling and installation.
1. Use a rolling block in rotating glass units to prevent damage to glass corners.
2. Use suction cups to shift glass units within openings.
3. Do not raise or drift glass with a pry bar.
4. When glass has flares or bevels along one horizontal edge that would occur in vicinity of setting blocks, install with flares or bevels at top of opening.
5. Use glazing tape and shims to position glass properly.

D. Remove and dispose of glass with edge damage or other imperfections of any kind that, when installed, would weaken glass and impair performance and appearance.

E. Install setting blocks of proper size at sill, located one-quarter of glass width from each corner, unless otherwise required. Set blocks in sealant acceptable for heel bead use.

F. Provide edge blocking to comply with requirements of GANA "Glazing Manual," except where otherwise required by glass fabricator.

G. Set units in each series with uniformity of pattern, draw, bow, and similar characteristics.

H. Compression Gaskets: Provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement.
1. Miter-cut at corners. Install as recommended by gasket manufacturer to prevent pull-away at corners.
2. Seal corner joints and butt joints with sealant recommended by gasket manufacturer.
3. Install gaskets to protrude slightly out of channel so as to eliminate dirt and moisture pockets.

I. Applied Films: Apply in accordance with manufacturer's specifications.
1. Film edges shall be cut neatly and square to a uniform distance of 1/8 inch to 1/16 inch of the window seating device.
2. Within 30 calendar days of application, film shall show no moisture dimples when viewed under normal viewing conditions.

3.2 PROTECTION AND CLEANING

A. Do not apply markers to surfaces of glass.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.

END OF SECTION

SECTION 08 91 00

METAL WALL LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Wall louvers and frames.

B. Related Requirements:
1. Metal Fabrications: Section 05 50 00.
2. Decorative Metal: Section 05 70 00.
3. Sheet Metal Flashing and Trim: Section 07 62 00.
4. Flexible Flashing and Underlayment: Section 07 65 00
5. Joint Sealants: Section 07 92 00.
6. Division 23: Heating, Ventilating, And Air-Conditioning (HVAC); louvers connected to ductwork.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00, “Submittal Procedures.”
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures,” and Section 01 78 36, “Warranties.”

1.3 ACTION SUBMITTALS

A. Shop Drawings: Indicate layout plan and elevations, and details of installation.

B. Product Data: Manufacturer's installation instructions and descriptive data of louvers and vents, including standard drawings and free area.

C. Samples: 12-inch length of each louver blade in specified finish.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's certification that louvers comply with requirements and are licensed to bear the AMCA seal, based on tests made according to AMCA 500 and complying with AMCA's Certified Ratings Program..

B. Sample copies of proposed warranty.

1.5 CLOSEOUT SUBMITTALS

A. Extended warranty.

1.6 FIELD CONDITIONS

A. Verify that field measurements are as indicated on shop drawings.

B. Coordinate with installation of exterior wall finish.

1.7 WARRANTY

A. Manufacturer: Furnish Owner with manufacturer's 20-year guarantee for finish against defects in materials and workmanship, including against delamination or pitting of finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Louvers: Construction Specialties Inc. (C/S), Airolite Company, Greenheck Louvers, Ruskin Manufacturing, or equal certified by AMCA.

2.2 MANUFACTURED UNITS

A. Aluminum Wall Louvers: Profile and performance requirements at each location; to be finalized by Architect.

B. Insect Screen: 16-x-18-mesh aluminum interior mounted in a rewirable extruded-aluminum frame.
1. Frame Finish: To match louver.
2. Attach to louvers with stainless steel screws.

2.3 FABRICATION

A. Shop-fabricate louvers in such a manner as to comply with requirements indicated for design, dimensions, materials, joinery, and performance.

B. Maintain equal blade spacing.

C. Frame: Channel shape with mechanically fastened corner joints.

D. Intermediate Mullions: Extruded aluminum, concealed, profile to suit louver frame.

E. Assemble louvers by welding.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check openings so as to assure that dimensions conform to Drawings.

3.2 INSTALLATION

A. Install louver assembly level and plumb and in accordance with manufacturer's recommended installation instructions.

B. Perimeter interior and exterior with sealant shall comply with Section 07 9200, "Joint Sealants."

C. Touch up of minor field abrasions and damage to factory-painted finish will be permitted if approved by Architect and touch-up is not unnoticeable in completed installation.

D. Seal perimeter interior and exterior with sealant specified in Section 07 92 00, "Joint Sealants."

3.3 ADJUSTING AND CLEANING

A. After initial inspection, remove labels, protective coating, and other foreign materials from aluminum surfaces.

B. Clean metalwork of smears, spots, and other markings. Comply with additional requirements for final cleaning specified in Section 01 74 23, "Final Cleaning."

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Delegated design of metal framing of nonbearing vertical and horizontal surfaces.

B. Related Requirements:
1. Delegated Design: Section 01 33 25 .
2. Structural Metal Stud Framing: Section 05 41 00; load-bearing framing at exterior walls.
3. Hollow Metal Doors and Frames: Section 08 11 13.
4. Suspension Systems: Section 09 22 26.
5. Gypsum Board: Section 09 29 00.
6. Acoustical Insulation and Sealants: Section 09 82 00; acoustical accessories including spring hangers and resilient sound isolation clips at ceilings.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action Submittals and Informational Submittals shall be submitted in accordance with Section 01 33 00, "Submittal Procedures."
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures.” and Section 01 78 36, “Warranties.”

1.3 ACTION SUBMITTALS

A. Product Data:
1. Specifications and installation instructions for each type of steel stud required to show compliance with specified requirements.
2. Manufactured top track for deflection relief, with UL approval data for each required condition and fire rating.
3. Manufactured drywall furring system, if used.
4. ICC-ES Report of framing system for stud gage and spacing for all wall conditions.

B. Delegated-Design: Engineering data prepared, signed, and sealed by the design engineer in responsible charge for framing systems to verifying stud gage and conformance with specified design and performance requirements for field conditions not covered by manufacturer’s product data.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification data for design engineer.

1.5 QUALITY ASSURANCE

A. Qualifications:
1. Installer: Company specializing in work of this Section with minimum 3 years' documented experience.

B. Regulatory Requirements:
1. Provide materials, accessories, and application procedures that have been listed by an approved testing agency or tested according to ASTM E119 for type of construction shown.
2. Framing system shall conform to ICC-ES for stud gage and spacing for all wall conditions.
3. Comply with American Welding Society (AWS) D1.1, "Structural Welding Code - Steel" for welding.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect metal studs and related materials from rusting and damage.
1. Comply with additional requirements specified in Section 01 60 00, "Product Requirements."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Metal Stud Systems: Cemco, ClarkDietrich Building Systems, Knorr Steel Framing Systems, Steeler, Inc., or accepted equal.

2.2 DESIGN AND PERFORMANCE CRITERIA

A. Wall Systems: Select steel studs in accordance with the manufacturer's standard load tables and the following design pressures and deflections:
1. Partitions to Receive Tile: L/360 at 10 psf.
2. All Other Partitions: L/240 at 5 psf.

B. Joisted ceiling deflection shall be designed to limit deflection to L/360.

C. Steel framing shall be isolated from building structure so as to prevent transfer of loading imposed by structural movement and at locations indicated below.
1. Where edges of suspended ceilings abut building structure horizontally at ceiling perimeters or penetration of structural elements.
2. Where partition framing abuts overhead structure. Provide slip-type joints as shown on the Drawings.

2.3 COMPONENTS

A. General: Metal studs, track, and sheet metal furring channels shall comply with ASTM C645.

B. Prefabricated, Steel Studs:
1. Gage and Width: As required to meet indicated criteria and as shown on the Drawings.
2. Shape: Roll-formed channel with punched openings along web and knurled flanges.
3. Finish: Galvanized, minimum G-40 coating meeting ASTM A653 and C955.

C. Joists: 16-gage steel C-shaped section with punched webs and 1-5/8-inch plain or perforated flanges to receive screws, ASTM A568 or A570 Grade 50, galvanized in accordance with ASTM A653 with G-60 coating.

D. Floor and Top Tracks: Cold-formed steel; ASTM A653
1. Grade to match stud used.

2. Gage: Equal to or heavier than stud used.
3. Width: Acceptable stud manufacturer's regular type or proper width for stud specified.
4. Top Track for Deflection Relief: "SLP-TRK" slotted single track by Dietrich Metal Framing, or equal.

E. Channels:
1. Cold-Rolled Channels: 16 gage, with factory-applied, rust-resistant paint.
2. Furring Channel, Screwable Type: 25 gage, cold-formed galvanized steel, hat shaped, 7/8 inch deep, with plain or knurled face to receive screws.
3. Resilient Furring Channels: Steel, asymmetric-shaped channel complying with ASTM C645, with face connected to a single flange by a single slotted leg (web); Dietrich “RCSN,” or equal.

F. Partition Stiffeners or Bridging: Specified cold-rolled channels or stud; manufacturer's standard bridging for approved stud.

G. Partition Strapping: 2-inch-wide metal strap, same gage as studs.

H. Wire: ASTM A641, Class 1 zinc coating, soft temper.
1. Bracing Wire: Minimum 0.106-inch nominal diameter (12 gage).
2. Tie Wire:
a. Single Strand: Minimum 0.062-inch nominal diameter (16 gage).
b. Double Strand: Minimum 0.048-inch nominal diameter (18 gage).

I. Backing Plates: To be shown on the Drawings.

J. Furnish clips, fasteners, anchorage devices, and miscellaneous components as required for completion of installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structure and conditions under which metal support systems will be installed.

3.2 GENERAL REQUIREMENTS

A. Comply with requirements of ASTM C754.

B. Wire Tying:
1. Use single-strand 16-gage or double-strand 18-gage tie wire.
2. Splicing: Double-wrap-tie.
3. Horizontal Stiffeners to Channel Brackets: Figure-eight tie.
4. Framing Members Perpendicular to Each Other: Saddle tie.

C. Deflection Relief at Non-Load-Bearing Walls and Partitions: Provide specified manufactured system for top track for deflection relief unless otherwise shown.
1. Cut studs short where abutting underside of steel construction.
2. Do not abut end studs to steel walls.
3. Secure ends of horizontal stiffeners to abutting steel or walls and columns.

3.3 INSTALLATION OF FIRE-RATED ASSEMBLIES

A. Install studs that are components of fire-rated partition in accordance with the requirements of governing authorities and codes.

B. Provide manufactured top track designed for deflection relief at top of fire-rated partitions.

3.4 APPLICATION OF FURRING CHANNELS

A. Space hat-shaped furring channels at 16 inches on center unless otherwise shown.

B. Secure furring with specified screws through holes in channel mounting flange.

3.5 ERECTION OF NON-STRUCTURAL STUDS

A. Tracks:
1. Align floor and top tracks.
2. Where studs run to structure, attach tracks to structure at maximum of 24 inches on center for powder-driven fasteners and 48 inches on center for expansion bolts, unless otherwise indicated.
3. Where studs run to a point just above ceiling line, anchor and/or brace as required to meet the design criteria.

B. Studs:
1. Plumb and align studs.
2. Space studs as indicated on the Drawings unless otherwise required for rated construction.
3. Where tile or stone is used on walls, decrease spacing or increase gage as required by tile or stone installer.
4. Attach studs to tracks by method recommended by stud manufacturer.
5. Do not splice studs.
6. At wall-mounted fixtures, casework, shelving, equipment, handrails, and grab bars, provide 16-gage or heavier studs at least 3-5/8 inches wide.

C. Horizontal Strapping: Place straps both sides of studs where unsupported height of studs exceeds 4 feet.

D. Horizontal Stiffeners: Brace studs with steel channel stiffeners placed horizontally at midpoint of the stud slot on inside of partition, if indicated on the Drawings or if recommended by the stud manufacturer. Secure as recommended by the stud manufacturer.

E. Install diagonal bracing at locations indicated or as required for frame stability and to resist seismic and lateral loads.

F. Weld Connections: Resistance-spot or projection-weld, fillet-weld, or plug-weld in accordance with recommended procedures and practices of AWS.

G. Framing Around Metal Frames for Doors and Sidelights:
1. Install double stud at each jamb of metal frame, continuous for full height of partition.
2. Secure stud to jamb anchors with screws.

H. Wall Intersections and Ends:
1. Form corners and intersections of partitions with three studs.
2. Place studs forming internal corners 2 inches from point of partition intersection.

I. Provide backing plates in wall to support wall-mounted items, including but not limited to wall-mounted casework, shelving, fixtures, equipment, handrails, grab bars, toilet accessories, and other locations as required by the various Sections of the Work.
   1. Attach backing plates, as specified, to carry loads required by CBC.
   2. Provide supplemental studs as required.

J. At walls that support wall-mounted items such as handrails, casework, or shelving and that do not extend to deck, brace studs to building structure so as to meet specified deflection criteria.

K. Framing at Curved Partitions:
   1. Cut runner track at 2 inches on center at outside edge, and bend to radius indicated on the Drawings.
   2. Provide 1-inch-by-25-gage metal strap, clinched to inside of leg of runner, in order to span gaps at outside edge.
      a. Secure to vertical leg of track with metal lock fasteners.
      b. Start first strap minimum 4 inches before beginning of radius.
   3. Curved tracks shall be preformed to "templates," field or shop welded. Do not use field-snipped or field-bent track.
   4. Space studs at 6 inches on center, a minimum of 1-foot tangent to arc (prior to starting of curve).
   5. Reduce standard stud spacing on arc so as to prevent flat areas between framing but not more than 12 inches on center.
   6. At Contractor's option, track may be bent to required radius in shop.

3.6 HORIZONTAL FRAMED SURFACES

A. Frame with specified joists, minimum 6-inch size, at 16 inches on center and as required to limit deflection as specified in Part 2 above.

B. Provide runner channels to receive framing at ceiling and walls of same gage as studs. Secure with mechanical fasteners at 24 inches on center maximum. Secure studs to channels with screws.

END OF SECTION

SECTION 09 24 00

PORTLAND CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Furring and lathing including:
   a. Metal accessories.
   b. Foam plant-on and inset shapes for field finishing.
   c. Sealable scaffolding attachment system.
2. Portland cement plaster scratch and brown coats with painted Portland cement finish coat over metal lath.
3. Portland cement plaster brown coat bonded to masonry or concrete with painted Portland cement finish coat.
4. Leveling coat.

B. Related Requirements:
1. Sheet Metal Flashing and Trim: Section 07 62 00.
2. Flexible Flashing and Underlayment: Section 07 65 00; sheet underlayment and self-adhesive flashing.
3. Joint Sealants: Section 07 92 00.
4. Security Lathing: Section 09 22 37; metal lath and accessories.
5. Gypsum Board: Section 09 29 00.
6. Painting and Coating: Section 09 90 00.

1.2 REFERENCES

A. ASTM International (ASTM):
1. C143: "Test Method for Slump of Hydraulic Cement Concrete."
2. C150: "Specification for Portland Cement."
3. C897: "Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters."
4. C926: “Specification for Application of Portland Cement-Based Plaster.”
5. C1861: “Standard Specification for Lathng and Furring Accessories, and Fasteners, for Interior and Exterior Portland Cement Based Plaster.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action Submittals and Informational Submittals shall be submitted in accordance with Section 01 33 00 Submittals.
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures.” and Section 01 78 36, “Warranties.”

B. Pre-installation Meeting: Prior to installation of Portland cement plaster work, Contractor, Architect, Owner’s waterproofing consultant, plaster installer, and other installers whose work may affect quality of installation shall meet at the Project site to coordinate related requirements and plastering.
1. Notify participants at least 5 working daysbefore conducting meeting.
2. Review material selections and procedures to be followed in performing the work.

3. Review in detail job conditions, schedule, construction sequence, curing procedures, required appearance of finish coat, and quality of completed installation.
4. Review underlayment, flashing, and lath installation with special attention to detailing of flashing at openings.
5. Review testing, inspection, and remedial repair procedures.
6. Review in detail the means of protecting completed work during remainder of construction period.
7. Contractor shall record discussions of conference and any conflict, incompatibility, or inadequacy and furnish a copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Show details for underlayment and flashing terminations, use of metal accessories and related fasteners, transitions, and penetrations.

B. Product Data: Manufacturer's published literature containing complete description for lath, metal accessories including fasteners, sealable scaffolding attachment system, and foam shapes; and instructions for mixing and application of plaster.

C. Samples: 12-inch-square panel showing finish coat texture. Finish coat shall be applied primer, if applicable, and base coats.

1.5 INFORMATIONAL SUBMITTALS

A. Statement of applicator qualifications.

B. Laboratory test reports, from a third party testing agency, for aggregates incorporated in Portland cement plaster.
1. Include testing for sulfate content, soluble salt content, and sieve size.
2. Testing shall comply with ASTM C897, “Aggregate for Job-Mixed Portland Cement-Based Plasters,” and the following ASTM testing methods:
   a. C40: Standard Test Method for Organic Impurities in Fine Aggregate.
   b. C88: Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
   c. C117: Standard Test Method for Materials Finer than 75- micro m (No. 200) Sieve in Mineral Aggregates by Washing.
   d. C123: Standard Test Method for Lightweight Particles in Aggregate.
   e. C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   f. C142: Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
   g. D2419: Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: Application of specified plaster system on at least three projects equal in scope to this Work.

B. Regulatory Requirements: Comply with requirements of CBC Article 25 and all local amendments, except as otherwise specified.

C. Industry Standards: Comply with applicable requirements of ASTM C847, ASTM C897, ASTM C926, and ASTM C1068.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Keep cement dry, stored off ground, under cover, and away from damp surfaces.

B. Remove wet and deteriorated materials from Project site.

C. Protect metallic materials and accessories from dampness or wetting.

D. Comply with additional requirements specified in Section 01 60 00, "Product Requirements."

1.8 FIELD CONDITIONS

A. Ambient Conditions:
1. Cold-Weather Requirements: Do not apply cement plaster, unless minimum ambient temperature has been at least 50 degrees F for at least 48 hours prior to application and temperature can be maintained at that level until plaster is cured.
2. Hot-Weather Requirements: Protect cement plaster from uneven and excessive evaporation during hot, dry weather.

B. Protection:
1. Protect finished surfaces installed prior to plastering as required to prevent damage.
2. Maintain protection in place until completion of plastering.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Match Existing.

B. PL1 – INTEGRAL COLOR ACRYLIC STUCCO - To be finalized by architect.
1. Location: See drawings.

2.2 ASSEMBLIES

A. Masonry: Leveling coat and finish coat with white cement, paint.

B. Framed Walls: Two layers of sheet underlayment, metal lath, scratch and brown coat, Portland cement finish coat, paint.

2.3 FURRING AND LATHING MATERIALS

A. Self-Furring Welded Wire Lath: Galvanized welded steel-wire fabric, 17-gage minimum, with openings not to exceed 1.5 inches, and conforming to ASTM C933. “Megalath” by Structa Wire, or accepted equal.
1. Weight: Not less than 1.95 pounds per square yard.
2. Provide with crimped cross wires forming a continuous 1/4-inch-deep furring crimp at nominal 3-inches on center.
3. Nominal Roll Size: Not less than 30 inches wide by manufacturer’s standard lengths.
4. Fabricate metal lath and furring from galvanized sheet steel complying with ASTM A653.

B. Expanded Metal Lath:
   1. Diamond Mesh: Expanded galvanized-steel sheets, ASTM C847.
      a. Flat: Not less than 2.5 pounds per square yard.
      b. Self-Furring: 3.4 pounds per square yard with dimpled indentations or continuous with 1/4-inch self-furring groove rolled lengthwise of sheet at maximum 6 inches on center to hold mesh 1/4 inch away from supporting surface.
   2. Rib Lath: Expanded galvanized-steel sheets, 3.4 pounds per square yard.
      a. At horizontal applications where support framing exceeds 16 inches on center, provide with V-shaped 3/8-inch ribs.
      b. Provide with Kraft paper backing at spray-on plaster applications.
   3. Nominal Sheet Size: 27 inches by 96 inches.

C. Protective Finishes:
   1. Galvanize all ferrous items, unless otherwise indicated.
   2. Fabricate metal lath and furring from galvanized sheet steel complying with ASTM A653.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that concrete surfaces are free from release agent and have been prepared in a manner which will insure proper adhesion of bonding agent.

B. Verify that support framing is spaced in accordance with code requirements.

C. Examine construction, grounds, and accessories to ensure that finished plaster surfaces will be true to line, level, and plumb, without requiring additional thickness of plaster.

D. Apply protective coverings to prevent application or spilling of plaster on surfaces not intended to receive plaster.

E. Verify that mortar joints in masonry surfaces are struck flush (non-tooled) and that mortar has properly cured.

F. Verify that gypsum board attachment to interior surface has been completed to minimize possible cement plaster cracking.

G. Verify that sheet underlayment and flashings have been applied and are acceptable at all locations.

3.2 PREPARATION

A. Where cold joints occur in concrete, use a heavy-duty glass-reinforced mesh over the joint and under the base coat. Embed mesh with an acrylic modified fiber reinforced adhesive equal to Dryvit "Genesis DS417" or STO "BTS."

B. Existing Masonry:
   1. Surfaces shall be sandblasted to remove paint and damaged or loose plaster.

2. After sandblasting, apply levelling coat in accordance with manufacturer's instructions to thickness not to exceed 3/8 inch. Levelling coat shall level gouges and deformations caused by sandblasting and provide even surface for application of finish coat.

C. New Masonry:
1. Apply bonding agent to masonry surfaces prior to application of metal lath.

3.3 INSTALLATION OF METAL LATH

A. General: Furring and lathing shall be installed in accordance with ASTM C1063.

B. Welded Wire Lath:
1. Unroll exercising care to minimize any undue distortions or stepping on the lath.
2. Apply with long dimension at right angles to supports.
3. Follow manufacturers' installation instructions for initial securing and fastening at each framing member at 6-inch intervals.
4. Secure with galvanized pan-head or washer head screws of sufficient length to penetrate into metal framing.
5. Stagger ends of lath to avoid continuous joints on same support.
6. Comply with manufacturer's recommendations for end and side laps.

3.4 INSTALLATION OF METAL ACCESSORIES

A. General:
1. Fasten in place using wire ties, galvanized staples, or hardened concrete nails as required to prevent dislodging or misalignment by subsequent operation. Corner aid and control and reveal joints shall be wire tied or fastened through self-adhering membrane shingled with adjacent underlayment.
2. Fasten at both ends and maximum 12 inches on center along sides.
3. Bring grounding edge of accessories to true lines, plumb, level, and straight.
4. Install accessories to provide required depth of plaster and to bring plaster surface to required plane.
5. Connect lengths of accessories as recommended by manufacturer to assure a continuous line.
6. Where plaster abuts dissimilar materials, terminate with plaster casing bead.
7. Install accessory beads to provide minimum 1/8-inch clearance between structural units and termination point of surface to receive plaster finish.
8. Install diagonal strip reinforcing at corners of doors, windows, and other openings.
9. Casing bead shall have continuous flange at corners. Cut and bent corners are acceptable only where the cut flange fully overlaps the adjacent flange and is fully sealed with sealant.
10. Seal all fasteners not driven squarely into substrate or exhibiting gaps around penetration through underlayment or self-adhering membrane. Fully seal around penetration, and tool sealant smooth.

B. Control, Expansion, and Reveal Joints:
1. Install at locations and at spacing shown on the Drawings by wire tying to metal lath.
a. If not shown, space control joints, as directed by the Architect, so as to provide plaster panels not exceeding 144 square feet with no dimension exceeding 18 feet or a length-to-width ratio of 2-1/2 to 1. For ceilings, the maximum size of panels shall not exceed 100 square feet.
2. Control Joints:
a. Set to serve as grounds for plaster.

b. Secure into place using tie wire, or fasten through self-adhering membrane shingled with adjacent underlayment.

3. Expansion Joints:
   a. Install double studs.
   b. Cut paper-backed metal lath at joints, but do not cut underlayment felt.
   c. Install self-adhering membrane backing behind expansion joints secured with fasteners. Shingle with installed underlayment to shed water.
4. Vertical control joints shall run continuous behind horizontal control or expansion joints. If vertical joints are interrupted by horizontal, apply sealant into the opening at the juncture.
5. Intersections of horizontal and vertical control or expansion joints and butted ends of adjoining sections shall be imbedded in sealant.
6.

C. Cornerite:
   1. Install at plastered interior angles where both converging wall surfaces are plastered.
   2. Do not install:
      a. Where metal lath continues onto converging surface of an angle at least 4 inches.
      b. Where juncture of abutting surfaces is to be unrestrained.
   3. Fasten along outer edges of lath only to secure firmly in position.
   4. Fasten to lath only, not to structural framing.

D. External Corner Aids: Provide at external angles where plastered on both sides of angles.

E. Drip Screed: Install where indicated on the Drawings. Apply bond breaker to drip to provide adequate weeping of cement plaster assembly and to avoid intimate bond.

F. Sealable Scaffold Attachment System: Attach in accordance with manufacturer's instructions and reviewed submittals. Coordinate with other Sections for structural attachment.

3.5 INSTALLATION OF FOAM SHAPES

A. To be finalized by architect; see locations in drawings. Secure in place as follows unless otherwise recommended by manufacturer.Cut to required lengths and install over cured brown coat free of any bond breaking materials or efflorescence.

C. Remove back wrapping and secure cloth and shape in place using specified adhesive mix. Run mix behind shape in vertical beads to allow for the escape of moisture between coat and back of foam shape. Beads shall be 3/8-inch diameter and spaced 1-1/2 inches apart.

D. Apply pressure over entire contact surface of foam to achieve uniform contact. Provide temporary support if required.

E. Where control or expansion joints terminate at foam shapes, seal ends watertight.

3.6 APPLICATION OF PLASTER - GENERAL

A. Comply with ASTM C926.

B. Apply first and second coats of three-coat system by hand or gun applied.

C. Grout hollow-metal frames occurring in plastered areas with base-coat plaster material, before lathing where necessary, at least 6 inches at each jamb anchor. Where casing bead does not

terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

D. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

E. Interrupt cement plaster only at junctions of plaster planes, at openings, and at control joints. Do not make cold joints in plaster.

F. Plaster Thickness Measured from Back Face of Lath: 7/8 inch typical.
1. First (Scratch) Coat: 3/8 inch minimum, 1/2 inch maximum.
2. Second (Brown) Coat: 1/4 inch minimum, 3/8 inch maximum.
3. Third (Finish) Coat: 1/8 inch minimum.

G. Plaster Thickness Measured from Face of Masonry: 1/2 inch minimum.
1. First (Brown) Coat: 3/8 inch minimum, 1/2 inch maximum.
2. Second (Finish) Coat: 1/8 inch minimum.

3.7 APPLICATION AT MASONRY

A. Apply leveling coat to masonry with a stainless steel trowel in accordance with manufacturer's instructions to a maximum thickness of 1/4-inch to provide a level skim coat ready to receive factory-prepared acrylic finish coat.

B. Embed manufacturer's standard 4.0 ounce mesh as a reinforcing and to serve as a gauging tool if recommended by manufacturer.

3.8 APPLICATION OF PLASTER BASE COATS

A. To reduce plaster cracking, apply plaster only after the building is 90 percent dead loaded and the interior gypsum has been installed.

B. Apply scratch coat with sufficient quantity of material to embed and fill all spaces of lath and to form keys through metal lath.

C. Apply scratch coat with sufficient material to embed and fill all spaces of lath and to form keys through metal lath.
1. Allow the scratch coat to set slightly, then score surface using metal scratching tool with teeth 1 inch apart.
2. Score surfaces in direction perpendicular to direction of supporting framing.

D. Apply brown coat to scratch coat, bringing out to grounds, flat to true surface.
1. Reconsolidate brown coat by floating or brushing to eliminate "slick spots" and assure a good mechanical bond with finish coat.
2. Where brown coat forms the substrate for adhered tile, finish with a wood float and level within 1/8 inch in 8 feet with no abrupt offset greater than 1/16 inch in 3 feet.
3. After brown coat is rodded and set but white it is still workable, check for 1/8 inch tolerance with a 10 foot straightedge. Correct deficiencies.
4. Completed brown coat shall be free of imperfections that would reflect in finish coat.

3.9 CURING OF PORTLAND CEMENT BASE COATS

A. Moist-cure scratch and brown coats.
1. Maintain moist conditions by fine fog spray.

2. Moist-curing conditions shall be continuously maintained. Moisture curing on weekends and holidays is required only in the event of temperatures exceeding 95 degrees F and/or winds in excess of 25 miles per hour, unless otherwise acceptable to Owner.
3. Dampen scratch coat immediately before applying brown coat, and brown coat immediately before applying finish coat.

B. Allow scratch coat to cure not less than 48 hours prior to application of brown coat. Do not use the “double-back method” of applying brown coat immediately after scratch coat has set or is “thumb-print” hard.

C. Permit brown coat to cure minimum 7 days after application prior to applying finish coat. Extend cure time for brown coat up to 21 days if recommended by manufacturer to reduce cracking if a smooth finish coat is selected.

D. The above curing times and methods shall be adjusted by Contractor for environmental conditions during the curing period as recommended in ASTM C926, Appendix.

3.10 APPLICATION OF FINISH COAT

A. Prior to application, surface irregularities in base coat, such as trowel marks, board lines, and reinforcing mesh laps shall be corrected.

B. Do not apply until portland cement base coats have been allowed to cure as specified.

C. Comply with in accordance with manufacturer's instructions, ASTM C926, and specified requirements to minimum 1/8 inch thickness.

D. Sufficient staging and workers shall be employed to accomplish a uniform appearance. All applicators shall use the same tools, equipment and techniques to achieve uniformity.

E. Cure proprietary finish in accordance with manufacturer's instructions.

F. [Do not apply until acrylic-modified leveling coat has dried as recommended by manufacturer.]

G. Comply with in accordance with manufacturer's instructions, ASTM C926, and specified requirements to minimum 1/8 inch thickness.

H. Apply finish coat to achieve approved appearance and textures.
1. Finish coat shall be applied and textured continually over a wall surface.
2. Maintain a wet edge at all times to obtain a uniform appearance.
3. Work to corners or joints, and do not allow the material to set up within a distinct wall area.

I. Sufficient staging and workers shall be employed to accomplish a uniform appearance. All applicators shall use the same tools, equipment and techniques to achieve uniformity.

J. Cure proprietary finish in accordance with manufacturer's instructions.

3.11 FIELD QUALITY CONTROL

A. Slump Test: Contractor shall be responsible for controlling the fluidity of each plaster mix. Mix may be subject to slump testing by the Owner, to verify proper fluidity, in accordance with

ASTM C143 using a slump cone 2 inches by 4 inches by 6 inches high. Slump shall be between 2-1/2 and 3 inches.

B. Installation Tolerances: Maximum deviation from true plane of 1/8 inch as measured from the line of a 10-foot straightedge placed at any location on surface unless lessor tolerance of 1/4as measured from the line of a 10-foot straightedge placed at any location on surface.

C. Repair cracks greater than 30 mils width, or otherwise objectionable by architect.

D. [Owner may hire an inspector and/or testing agency in accordance with Section 01 4500, "Testing Services."]

E. [Comply with requirements of Section 01 9115, “Building Envelope Commissioning” and Section 01 9116, “Building Envelope Testing Protocols.”]

3.12 ADJUSTING AND CLEANING

A. Patching:
1. Point up plaster around trim and other locations where plaster meets other materials.
2. Cut out and patch defective or damaged plaster.
3. Match patch of defective or damaged plaster to existing work in form, color, and texture.
4. Patch shall be continuous to corner or control joint.

B. Cleaning: Remove plaster and protective materials from expansion beads, perimeter beads, and adjacent surfaces.

C. Wash Portland cement plaster to remove excess alkalinity.

D. After washing, field test for alkalinity; pH of surface shall not exceed 13.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Gypsum board, including finishing.

B. Related Requirements:
1. Structural Metal Stud Framing: Section 05 4000; exterior load-bearing wall framing.
2. Miscellaneous Rough Carpentry: Section 06 1053.
3. Gypsum Sheathing: Section 06 1643.
4. Firestopping: Section 07 8400; fire-rated sealants.
5. Access Doors and Panels: Section 08 3100.
6. Gypsum Board Shaft-Wall Assemblies: Section 09 2116.
7. Non-Structural Metal Framing: Section 09 2216.
8. Tiling: Section 09 3000.
9. Acoustic Insulation and Sealants: Section 09 8200; acoustical sealants and sound control requirements.
10. Painting and Coating: Section 09 9000.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300 “Submittal Procedures.”
2. Closeout Submittals shall be submitted in accordance with Section 01 7700 “Closeout Procedures” and Section 01 7836 “Warranties.”

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's product data for the following system materials.
1. Each type of gypsum board and finishing product.
2. Metal accessories.

B. Samples:
1. Each type or configuration of extruded aluminum reveal, finished as specified, including intersections and other special components.
2. Panels 10 inches square, on suitable backing, of specified texture finish.
a. Resubmit samples, as required, until finish desired by Architect is achieved.
b. One-half of panel shall have specified paint finish.]

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Fire-Resistance Ratings:
a. Comply with fire-resistance ratings as indicated and required by governing authorities and codes.
b. Provide materials, accessories, and application procedures that have been listed by a nationally recognized testing agency or tested according to ASTM E119 for type of construction shown.

2. Comply with the CBC, Chapter 25.

B. Industry Standards: Work shall comply with the applicable requirements of GA publication GA-216 and GA-214.

C. Installer Qualifications: Company specializing in work similar to that required on this Project, with documented experience.

D. Notify Architect prior to covering or enclosing framing, ducts, and pipes in sound-rated construction in order to allow for on-site review and correction as required.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials in dry location, fully protected from weather, direct exposure to sunlight, and damage from other construction activity.

B. Stack gypsum board products flat and level, properly supported in such a manner as to prevent sagging or damage to ends and edges.

C. Store metal and plastic accessories so as to prevent bending, sagging, distortion, or other mechanical damage.

D. Do not store or stack gypsum board on floors of new work with an equivalent loading in excess of 50 pounds per square foot.

E. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.6 FIELD CONDITIONS

A. Ambient Conditions: Maintain temperature in installation area in accordance with GA-216 requirements. Provide supplemental heat as required to maintain minimum temperatures specified in GA-216.

B. Ventilation:
1. Provide controlled ventilation during joint finishing in order to eliminate excessive moisture.

C. Avoid drafts during hot, dry weather in order to prevent excessively fast drying of joint compound.

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

A. Fire Rated Gypsum Board: “Firecode” by USG, or equal.
1. ASTM C1396, Type X, unless more stringent type required by code.
2. Thickness: 5/8 inch.

B. Fire-Rated Moisture- and Mold-Resistant Board: “Mold Tough Firecode Core” by USG, or equal.
1. ASTM C1396, Type X, unless more stringent required by code.
2. Thickness: 5/8 inch.

3. Mold Resistance: 10 on scale of 10 in when tested accordance with ASTM D3273.
4. Moisture Resistance: The average water absorption for panels shall not exceed 5 percent by weight after two-hour immersion when tested in accordance with ASTM C473.

C. Gypsum Board, Type C: ASTM C 1396, manufactured to have increased fire-resistive capability; “Sheetrock Firecode C Core” by USG, or equal.
1. Thickness: 5/8 inch, unless otherwise noted, and as required by fire-resistance-rated assembly.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

D. Abuse Resistant Gypsum Board: Fire rated Type X abuse resistant gypsum board. “Fiberock VHI Abuse Resistant” by USG, or equal.
1. Thickness: 5/8 inch.
2. Indentation Resistance: ASTM C1629; Level 1.
3. Hard Body Impact: ASTM C1629 Annex A.1; Level 3.
4. Soft Body Impact Resistance: ASTM C1629; Level 3.

2.2 ACCESSORIES

A. Wall Board Screws: Phillips head with bugle shape, Type S conforming to ASTM C1002. Provide Type W at wood backing.

B. Concealed Metal Reinforcements and Casing: Electrogalvanized, conforming to ASTM C1047.

C. Joint-Treatment Materials: Comply with ASTM C475 and with manufacturer's recommendations for specific project conditions.

D. Miscellaneous Items: Furnish components not specified but shown on the Drawings and other items required to complete the installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check framing for accurate spacing and alignment.

B. Verify that spacing of installed framing does not exceed maximum allowable for thickness of gypsum board to be used.

C. Do not proceed with installation of gypsum board until deficiencies are corrected and surfaces to receive gypsum board are acceptable.

D. Repair protrusions of framing, twisted framing members, or unaligned members before starting installation of gypsum board.

3.2 APPLICATION OF GYPSUM BOARD

A. General: Comply with ASTM C840, GA-216, and SFBC. Where UL designs are indicated on the Drawings for fire-rated partitions, comply with UL requirements, except where exceeded

by other requirements. Refer to Article “Installation of Acoustical Insulation” in Section 09 82 00 “Acoustical Insulation and Sealants” for additional information.

1. Wherever possible, install gypsum board in such a manner as to minimize butt end joints.
2. Apply ceiling boards prior to installation of wall boards. Arrange so as to minimize butt end joints near center of ceiling area.
3. Install wall boards in such a manner as will minimize butt end joints in center of wall area. Stagger vertical joints on opposite sides of walls. Stagger horizontal joints where required by governing code.
4. Butt all joints loosely, with maximum of 1/16 inch between boards.
5. Place wrapped edges adjacent to one another. Do not place cut edges or butt ends adjacent to wrapped edges.
6. Support all edges and ends of each board on framing or by solid substrate, except that long edges at right angles to framing members in non-fire-rated construction may be left unsupported, unless required by SFBC.

B. Single-Layer Application:
1. Install gypsum board by means of screw attachment.
2. On walls and partitions, plan installation so that leading edge or end of gypsum board is attached to open end of stud flange first.
3. Mark location of ceiling joists and studs. Do not locate screws attaching gypsum board to channels within 2 inches of joists or studs.

C. Double-Layer Application:
1. Apply base layer vertically, offsetting vertical joints at least one stud space between layers.
   a. Install base layer by means of screw attachment.
   b. Provide fire taping only.
2. Precut and fit face layer by laminating to base layer with adhesive.
3. Provide temporary support for face layer, by fasteners or shoring, until adhesive is dry.
4. At Contractor's option, provide permanent support by attaching face layer to base layer with screws in accordance with manufacturer's instructions.
5. Sound-rated Edge Condition:
   a. Stagger or ship-lap gypsum board layers at vertical intersections.
   b. Provide a 1/4-inch nominal gap around the gypsum board face layer at floor and ceiling intersections. Fill the 1/4-inch gap with acoustical sealant to form an airtight seal.

D. Install specified moisture-and-mold-resistant board complying with manufacturer's recommendations for installation, including minimum clearances and sealing of penetrations and edges.

E. Metal Trim:
1. Apply “L” or “J” trim at all exterior corners and at interior corners where gypsum board intersects window or storefront mullion, concrete, or other dissimilar material.
2. Install in longest lengths practicable.
3. Run trim straight and square with all planes.
4. Edges:
   a. Apply applicable shape of metal edge trim at exposed edges of wallboard and where otherwise shown.
   b. Gypsum Board Abutting Other Materials: Install edge trim with 1/8-inch clearance to allow for sealant.
   c. Apply neoprene tape where shown to assure sealed joints at abutting surfaces.
      1) Install in longest lengths practicable.

2) Adhere to edge trim prior to installation of trim.
3) Coordinate application of tape with installation of metal framing as specified in Section 09 22 16 "Non-Structural Metal Framing."

5. External Corners: Apply metal corner beads at external corners in single lengths, unless details clearly indicate its omission at specific locations.

F. Control Joints:
1. General: Install control joints according to ASTM C840 and in specific locations approved by City Representative for visual effect.
2. Ceilings (C-2): Back with continuous furring channels each side, spaced 2-1/4 inches apart, centered on break.
3. Fire-Rated Ceilings: Install 2 inch-wide continuous strip of wallboard between channels of same thickness as ceiling board.
a. Butt strip against one channel in order to permit 1/4-inch clearance.
b. Secure butted side to ceiling wallboard with adhesive.
4. Partitions: Back with double studs.

G. Remove and replace sheets damaged in handling or installation.

H. For conditions not specified or shown on the Drawings, follow procedures recommended by the gypsum board manufacturer.

I. Leave gypsum board in a clean condition, ready for taping and painting.

3.3 SOUND-RATED CONSTRUCTION

A. Comply with requirements for sealing penetrations at sound-rated construction as specified in Section 09 82 00 "Acoustical Insulation and Sealants."

3.4 FIELD QUALITY CONTROL

A. Construction Tolerances:
1. Gypsum board surfaces to be painted shall have no measurable variation in any 2-foot direction and a maximum variation of 1/8 inch in 10 feet 0 inches when a straightedge is laid on the surface in any direction.
2. See Section 09 30 00 “Tiling” for tolerances required for surfaces to receive tile.
3. Shim work as required to comply with specified tolerances.
4. Do not exceed 1/16-inch offset between planes of abutting sheets at edges or ends.

3.5 TAPING AND FINISHING

A. Gypsum board partitions shall be appropriately prepared for finish indicated on the Drawings.

B. General Requirements:
1. Apply finishing compounds in accordance with manufacturer's directions. Do not apply tape and joint compound over joints containing acoustical sealant until the sealant has completely cured.
2. Center tape over joint, and embed in uniform layer of joint compound of sufficient width and depth to provide firm and complete bond.
a. Apply skim coat while embedding tape.
b. Apply second coat, where required by Level of Finish, after skim coat has hardened and been sanded.
c. Apply finish coat, and sand smooth, flush with adjacent surfaces.

d. Use appropriate water-resistant compound at moisture and mold resistant gypsum board filling all fastener heads, penetrations, and joints.

3. Treat angles with reinforcing tape, folded to conform to adjacent surfaces and with straight, true angles.
4. Provide minimum 24 hours' drying time between applications of compounds.
5. Conceal flanges of metal reinforcement with minimum two coats compound. Compound shall extend 8 to 10 inches each side of metal nosing.

C. Level of Finishes: In accordance with GA-214 and the following, subject to finalization by the Design-Builder and approval by the Construction Manager.
1. Locations to Receive "Fire-Taping" and at Unexposed Gypsum Board Applications: Level 1.
2. Wall Surfaces to Receive Tile: Level 3.
3. Ceilings and Wall Surfaces in Lobbies and Other Public Spaces: Level 4.
4. Walls to Receive Wall Covering and Over 1 Story High: Level 5.
5. All Other Locations: Level 4.

3.6 ACCESS DOORS AND PANELS

A. Install access doors and panels where required for access to concealed equipment and for mechanical and electrical work specified in Divisions 22, 23, and 26.

B. Meet the requirements of Section 08 31 00 “Access Doors and Panels.”

3.7 PROTECTION OF FINISHED WORK

A. Provide proper procedures for protection of completed gypsum board from damage or deterioration until final acceptance of the Project.

END OF SECTION

SECTION 09 51 23

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Suspended acoustical ceiling panels to match existing ceiling panels.
2. Ceiling suspension system.

B. Related Requirements:
1. Heating, Ventilating, and Air-Conditioning (HVAC): Division 23; air diffusers.
2. Electrical: Division 26; lighting fixtures.
3. Standard suspended ceiling details on the Drawings.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action and Informational Submittals shall be submitted in accordance with Section 01 30 00 “Submittal Procedures.”
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00 “Closeout Procedures” and Section 01 78 36 “Warranties.”

B. Coordination:
1. Develop and coordinate locations of work supported by or penetrating through ceiling with the other Sections involved prior to making shop drawing submittal. In particular, note partitions that are to be installed prior to ceiling installation.
2. Provide additional hangers and inserts as required.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Include the following:
1. Layout of suspension system and location of hangers, seismic braces, and trapezes.
2. Inserts and hanger spacing and fastening details.
3. Trapeze details.
4. Splicing method for main and cross runners.
5. Support of ceiling fixtures and air diffusers, and support of adjacent acoustical panels.
6. Details at changes in ceiling level.
7. Locations and dimensions of access doors, light fixtures, supply and exhaust grilles and diffusers, sprinkler heads, speakers, detection devices, and all other items to be installed in suspended acoustical ceilings.
8. Pattern of mechanical fasteners where used in an exposed location.
9. Seismic control details.

B. Product Data: Manufacturer's catalog cuts for new and replacement suspension system components and acoustical panels.
1. Data sheets shall be marked to identify specific products proposed for use.
2. Include ICC-ES Report for seismic clips.

C. Samples:
1. 6-inch x 6-inch sample of each type of acoustical panel required.

2. 8-inch-long sample of each type of exposed suspension member and trim, showing profile and finish.

D. Delegated Design: Seismic and structural design engineering calculations prepared by the engineer in responsible charge retained by the Contractor shall be submitted to demonstrate compliance with CBC and adequacy of suspension system to withstand specified seismic and structural loading. Engineer shall be a California licensed civil or structural engineer.

E. Sustainable Design Requirements:
1. Sustainable Design: Compliance with the California Green Building Standards Code (CALGreen) goals for this Project.
2. Sustainable design submittals are in addition to other submittals.
3. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal.

1.4 MAINTENANCE SUBMITTALS

A. Acoustical Units: Furnish extra material equal to two full cases of the material manufacturer for each acoustical panel product provided on the Project.
1. Suspension System Components and Trim: Furnish quantity of each exposed suspension component equal to two percent of amount installed.
2. Deliver to Owner in sealed containers of the material manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Warranties as specified.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Minimum of three installations of extent comparable to Project.

B. Mockups:

C. First installed area or example of each ceiling system and each type of trim shall serve as a mockup for review by Owner Representative of workmanship, visual effect, and interface with adjacent construction.
1. Comply with additional requirements of Section 01 43 39 "Mockup Requirements."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver with manufacturer's labels indicating brand name, pattern, size, thickness.

B. Store cartons open at each end to stabilize moisture content and temperature.

C. Do not begin installation until sufficient materials to complete a room are received.

D. Comply with additional requirements specified in Section 01 60 00 "Product Requirements."

1.8 FIELD CONDITIONS

A. Ambient Conditions, Unless Otherwise Acceptable to Material Manufacturer:
1. Do not install acoustical ceilings until sufficient heat is provided, and dust-generating activities have been terminated.

2. Maintain a uniform temperature between 55 and 70 degrees F prior to and during installation of materials.

B. Do not install acoustical ceilings until work above ceilings is completed, including testing and approval of mechanical work.

C. Notify Owner Representative, in writing, of any conditions preventing proper application of acoustical ceilings.

1.9 WARRANTY

A. Provide the following extended product warranties by manufacturer:
1. Acoustical Panels: 10 years.
2. Suspension Grid and Trim: 10 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Basis of design as listed with individual products, or equal.

B. Products of other manufacturers will be considered for substitution, provided that materials match designated products in color, texture, appearance, and performance to Owner Representative's satisfaction.

2.2 DESIGN AND PERFORMANCE CRITERIA

A. General: This Specification is intended to supplement the information for suspended ceilings included on the Drawings. Where a conflict occurs, Contractor shall comply with the more stringent requirement.

B. Seismic Requirements:
1. Ceilings shall comply with CBC requirements for seismic bracing of ceiling suspension system.
2. Ceiling Compression Struts:
a. Provide struts as shown on Drawings and as required by code.
b. Bracing system shall be adequate to support nonbearing ceiling-height partitions spaced at 10 feet on center.

C. Fire Performance Characteristics:
1. Surface Burning Characteristics: Provide products complying with ASTM E 1264 for Class A products and meeting the following when tested in accordance with ASTM E84.
a. Flame Spread: 25 or less.
b. Smoke Developed: 50 or less.

D. Tolerances:
1. Deflection, ASTM C635: Maximum 1/360 of span. Applies to suspension system components, hangers, and fastening devices supporting light fixtures, ceiling grilles, and to acoustical panels.
2. Allowable Tolerance of Finished Acoustical Ceiling System: Level within 1/8 inch in 12 feet.

2.3 SUSPENSION SYSTEMS

A. Comply with ASTM C635.

B. Structural Classification: Heavy-duty.

C. Main and Cross Members: Hot-dip galvanized cold-rolled steel, double-web design with rolled-steel cap.

D. Edge Moldings: Hot-dip galvanized, cold-rolled steel, minimum 0.020-inch-thick steel.
1. Profile, Unless Otherwise Shown: Channel, minimum flange width of 15/16 inch.

E. Splices, End Connections, Clips, and Other Accessories:
1. Hot-dip galvanized steel.
2. Design to provide strong, rigid, lock-type connections preventing movement or displacement of joined components and permitting disassembly without damage to component parts.

F. Suspension Wire: ASTM A641, Class 1 zinc coating, soft temper.
1. Hanger Wire: 0.106-inch nominal diameter (12 gage).
2. Bracing Wire: 0.120-inch nominal diameter (10 gage).

G. Attachment Devices: Size for five times design load required by ASTM C635,Table 1, Direct Hung, unless otherwise indicated.

H. Compression Struts: Donn "Seismic Compression Post" or equal manufactured proprietary product conforming to specified requirements and those indicated on the Drawings.

I. Hold-Down Clips: Concealed, spring-loaded, fully accessible.

J. Finishes:
1. Steel components shall be Bonderized and given a coat of rust-inhibitive paint.
2. Exposed surfaces of components shall have factory-applied semi-gloss white enamel finish, unless otherwise noted.
3. Grid Color: White, unless otherwise specified.

K. Suspension and Grid Types: As specified under Article “Acoustical Panel Ceiling Types.”

2.4 ACOUSTICAL PANEL CEILING TYPES

A. Type C-1:
1. Grid: Direct-hung, exposed tee grid, 15/16 inch wide, white color; "Prelude XL” by Armstrong, System 1200 by Chicago Metallic Corp, USG Interiors Inc., or equal.
a. Color: as selected by architect.
2. Lay-in Panels: 5/8 inch x 24 inches x 48 inches; Manufacturer; TBD by Architect
a. Texture: Fine.
b. Finish: Factory-applied, washable white vinyl facing.
c. Color: White.
d. NRC: 0.70.
e. Bacterial, mold, mildew, soil and moisture resistant.
f. Fire rating: Class A in accordance with ASTM E84.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pattern shall be accepted by Owner Representative before installation of suspension system.

B. Install suspension system, including necessary hangers, grillage, and other supporting hardware in accordance with CBC, ASTM C636 and ASTM E580, manufacturer's instructions, suspended ceiling details and notes on the Drawings, and as specified. The most stringent requirements shall govern.

1. Hangers:
   a. Coordinate supplemental and new hanger locations with other work. Hanger wire attachment devices shall be capable of supporting 100 pounds.
   b. Ensure that hangers and carrying channels are located to accommodate fittings and equipment that are to be placed after installation of ceiling grid system.
   c. Install additional hangers at ends of each suspension member, at light fixtures, and 6 inches from vertical surfaces.
   d. Do not splay wires more than 5 inches in a 4 foot vertical drop.
   e. Wrap wire at least three times horizontally, turning ends upward in the first 3 inches.
   f. Provide trapeze suspension or other appropriate system for suspension of ceiling system and light fixtures at large ductwork.
   g. Provide two extra tie wires at each light fixture and HVAC register for use in tying off opposite corners at fixtures and registers.
   h. Kinks and bends are not permitted in hanger wires to level carrying channels.
   i. Provide supplemental wire hangers for cross corridor primary beams at locations required by system manufacturer.
2. Main and Cross Runners:
   a. Space main runners at 4 feet on center.
   b. Level and square to adjacent walls.
   c. Use standard "Tee" section at grid change in direction.
   d. Independently support a maximum of 8 inches from each wall.
   e. Secure to structure above with four-way, bracing wire splays as specified and shown on the Drawings.
   f. Space cross runners at 2 feet on center.
3. Wall and Perimeter Moldings:
   a. Install wall molding at intersection of suspended ceiling and vertical surfaces.
   b. Miter corners where wall moldings intersect.
   c. Fasteners shall be concealed.
4. Seismic Bracing Assembly: Compression struts and splayed wires as indicated on the Drawings.
   a. Splices in bracing wires are not permitted.
   b. Compression struts shall not replace hanger wires. If a manufactured proprietary strut is used, it shall be approved by the Owner.
   c. Ceiling areas exceeding 2,500 square feet shall have a seismic separation joint with each area provided with closure angles.
   d. Seismic perimeter clips shall have current and approved ICC-ES Report and shall be installed in accordance with the details and recommendations of the Report.
   e. Provide spreader bars at all main and perimeter runners.
5. Provide bracing to top of ceiling-height partitions as indicated on the Drawings.

C. Lay-in Acoustical Panels:
   1. Install in grid system in accordance with manufacturer's recommendations and procedures in CISCA publication "Acoustical Ceiling Use and Practice." CBC shall govern if in conflict or more restrictive than CISCA publication.
   2. Install in level plane in straight line courses.
   3. Apply with grain, if any, in same direction, not checkerboard.
   4. Minimum Width of Border Panel: One-half panel dimension, unless indicated on the Drawings or approved submittals.
   5. Provide trim molding at recessed troffer lights as required.
   6. Hold-Down Clips:
      a. Acoustical panels surrounding recessed troffer lights shall be installed with hold-down clips to prevent movement or displacement of panels.
      b. Provide hold-down clips at perimeter where grid meets wall molding.
      c. Exposed fasteners are not acceptable.
   7. Coordinate lay-in system with electrical fixtures and mechanical work that will be integrated with the ceiling.

D. Ceiling Mounted Light Fixtures and HVAC Terminals:
   1. Secure with mechanical fasteners to the ceiling grid runners to resist a horizontal force equal to the weight of the fixture.
   2. Independently support with wires to structure above as follows:
      a. Fixtures less than 10 Pounds: One 12-gage wire from the fixture housing. This wire may be slack.
      b. Fixtures between 11 and 55 Pounds: Two 12-gage wires attached to fixture and structure above. These wires may be slack.
      c. Fixtures 56 pounds and more shall be independently supported using 9-gage wire:
   3. Fasteners shall be concealed in completed installation.

3.2 CLEANING

A. Clean soiled or discolored surfaces after installation.

B. Touch up scratches, abrasions, voids, and other defects in painted surfaces.

C. Remove and replace damaged or improperly installed work.

END OF SECTION

SECTION 09 67 23

RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Self-leveling, fluid-applied, resinous flooring systems and base, referred to on the Drawings as “Epoxy,” including applicable surface preparation and detail work.

B. Related Requirements:
   1. Concrete Moisture Testing: Section 01 4520.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
   1. Action and Informational Submittals shall be submitted in accordance with Section 01 3300, “Submittal Procedures.”
   2. Closeout Submittals shall be submitted in accordance with Section 01 7700, “Closeout Procedures,” and Section 01 7836, “Warranties.”

B. Pre-Installation Meeting: A pre-installation meeting shall be held between applicator, Contractor, and the Architect to review surface preparation, priming, application, curing, protection, and coordination with other work

C. Sequence flooring installation with other work to minimize possibility of damage and soiling during remainder of construction period.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer’s product data sheets on each product and system to be used including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements.
   3. Installation methods.
   4. Maintenance requirements.
   5. Manufacturer’s color charts representing manufacturer’s full range of colors and patterns.

B. Samples: Selected color, texture, and gloss, not less than 6 inches square, prepared on suitable backing for review by Architect at jobsite. Prepare for each system and color.

1.4 INFORMATIONAL SUBMITTALS

A. Quality Assurance: Applicator qualifications and verification that applicator is approved and certified by coating system manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturer’s recommended cleaning and maintenance instructions for the floor system.

1.6 QUALITY ASSURANCE

A. Qualifications:
1. Applicator: Note less than 5 years; experience in installation of epoxy flooring systems and confirmed and certified by the manufacturer in all phases of surface preparation and application of the product specified.
2. Applicator's Personnel: Employ only persons trained for application of specified materials.

B. Mockup:
1. First installed example of each installation condition of epoxy floor coating shall serve as a mockup for review by Architect of workmanship, visual effect, slip resistance, and interface with adjacent construction.
2. Location shall be approved by Architect.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to the job site in sealed, undamaged containers. Each container shall be clearly marked with manufacturer’s label showing type of material, color, and lot number.

B. Store materials in a clean, dry place with a temperature range in accordance with manufacturer’s instructions.

C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 FIELD CONDITIONS

A. Protect concrete flat work during curing and subsequent construction activities as required to prevent damage by impact or stains from rubbish and the work of other trades.

B. Storage area and surface of concrete shall be maintained at temperatures required by coating manufacturer.

PART 2 - PRODUCTS

2.1 DESIGN AN PERFORMANCE CRITERIA

A. System shall be certified "High Traction" by the National Floor Safety Institute (NFSI).

B. Slip Resistance: Completed flooring shall provide a value equal to or greater than 0.42 when tested in accordance with DCOF AcuTest procedure contained in ANSI A137.1:2012, Section 9.6.
1. If manufacturer of selected flooring does not have test data to substantiate compliance with DCOF AcuTest value, provide alternative testing to verify compliance, including static coefficient value of 0.60 for level surfaces as determined by testing identical products in accordance with ASTM C1028, if acceptable to governing authorities.
2. Laboratory tests shall be made on a minimum of sample panels of system proposed for use.

C. Fire Performance Characteristics:
1. Critical Radiant Flux: Class I material when tested in accordance with ASTM E648 (NFPA 253).

2.2 FLUID-APPLIED FLOOR COATING

A. Resinous Flooring (“F-1”): Self-leveling, urethane topcoat, seamless flooring system; “Dex-O-Tex Décor-Flor Broadcast System” by, Crossfield Products as specified and scheduled, or accepted equal.

C. Mix and application of each coating shall be designed to meet required slip-resistance.

2.3 INSTALLATION

A. Apply Flooring System components according to manufacturer's written instructions. Produce a uniform, monolithic wearing surface of thickness, color and texture indicated.
1. Coordinate application of components. Provide optimum adhesion of coatings to substrate, and optimum intercoat adhesion.
2. Cure coatings per manufacturer's written instructions. Prevent contamination during application and curing processes.
3. Expansion, Isolation and Control Joint Treatment: At substrate expansion, isolation and control joints, comply with resinous flooring manufacturer's written instructions.
4. Contractor shall keep daily logs recording the work performed and environmental conditions as required by the materials manufacturer.

B. Vapor Control Primer Membrane: Apply over prepared substrate at required spreading rate.

C. Install integral 4” cove base with 5/8” radius.

D. Crack Isolation/Anti-Fracture Membrane: After Surface Preparation, route out cracks greater than 60 mils. Vacuum cracks and surrounding surface. Remove dust and debris. Fill cracks with flexibilized epoxy membrane. Strip with fabric reinforcement 2 inches (51 mm) on both sides of cracks or per manufacturer's recommendations.
1. Application Location: Substrate cracks.
2. Application Location: Entire substrate surface.

E. Self-Leveling Body Coats: Apply in thickness indicated for flooring system.
1. Aggregates: Broadcast aggregates at rate recommended by manufacturer. After resin cures, remove excess aggregates. Provide surface texture indicated.

F. Grout Coat: Apply type recommended by resinous flooring manufacturer, to fill voids in final body coat surface.

G. Top Coat: Quik-Glaze Clear Gloss. Apply in number indicated for flooring system and at spreading rates recommended by manufacturer to produce wearing surface indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect substrate in order to verify that it is satisfactory. Substrate shall be free of the following:
1. Excess moisture, as determined by testing.
2. Cracks, holes, ridges, coatings preventing adhesive bond.
3. Other defects impairing performance or appearance.

B. Flatness Tolerance of Substrate: 1/8 inch maximum between high spots when measured with 10-foot straightedge and such that finish floor will not show "telegraphing" of irregularities.

Conduct surface profile inspection according to International Concrete Repair Institute (ICRI) Technical Guideline No. 03732.

3.2 SURFACE PREPARATION

A. Prepare surfaces using methods recommended by the manufacturer for achieving the required surface profile.
   1. Comply with ASTM F710 and minimum CSP #4 mechanical surface preparation as described in the International Concrete Repair Institute (ICRI) Guidelines.
   2. Do not use chemical abatement methods.

B. Perform moisture and alkalinity tests on concrete as specified in Section 01 4520, “Concrete Moisture Testing,” to verify that substrate is sufficiently dry and of alkalinity within limits required of flooring manufacturer.
   1. If slab moisture content, relative humidity, or alkalinity exceeds requirements of manufacturer, do not proceed with installation; and immediately notify the Architect for further direction.
   2. Although specific testing methods and procedures are specified, test methods shall be as recommended by or as acceptable to the flooring manufacturer.

C. Perform bond tests to ascertain presence of substances detrimental to obtaining adhesive bond.

D. Joints: Fill with specified compound using methods to assure fill will not telegraph though topcoat.

E. Do not proceed with application of coating until concrete is acceptable.

3.3 APPLICATION OF COVE BASE

A. Install integral cove base before applying flooring.

B. Prime surfaces with brush or roller before application of mortar using primer material recommended by flooring system manufacturer. If system components are used, allow to set approximately 30-45 minutes before application of the mortar.

C. Cove up at walls and other vertical interruptions to height as shown.
   1. Apply mortar from the bottom and spreading upwards firmly on the vertical with a spring steel trowel.
   2. Tool radius after mortar is placed on the vertical surface.
   3. Treat trowel as recommended by manufacturer to reduce resin stickiness and to achieve a smooth finish.

D. Allow mortar to set sufficiently before proceeding with application of primer coat.

3.4 APPLICATION OF FLUID-APPLIED FLOOR COATING “EPOX-1”

3.5 APPLICATION OF FLUID-APPLIED FLOOR COATING “EPOX-2”
   1. CURING

G. Allow the coating to cure for a minimum 24 hours after application before opening the floor to light traffic. Allow more time for low temperatures and higher humidity or for heavier traffic.

H. Full coating properties of specified coating may take up to 7 days to develop.

3.6 FIELD QUALITY CONTROL

A. Verify coatings and other materials are as specified.

B. Verify coverages of the system as work progresses. Areas found not to meet the required thickness shall receive additional material until specified thickness is attained.

C. Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of the coating system.

3.7 PROTECTING AND ADJUSTING

A. Installation areas must be kept free from traffic and other trades during the application procedure and cure time.

B. Protect finished surfaces of coating system from damage during remainder of construction.

C. Touch-up, repair or replace damaged flooring system shall only be performed if approved by the coting system manufacturer and are subject to approval of the Architect.

END OF SECTION

SECTION 09 82 00

ACOUSTICAL INSULATION AND SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Acoustic batt insulation.
2. Acoustical sealants and accessories.
3. Sound isolation requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action Submittals and Informational Submittals shall be submitted in accordance with Section 01 3300, “Submittals.”
2. Closeout Submittals shall be submitted in accordance with Section 01 7700, “Contract Closeout,” and Section 01 7836, “Warranties.”

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications for each type of insulation and sealant.

B. Samples: Each type of pipe isolation system or product.

1.4 QUALITY ASSURANCE

A. Comply with Flame Spread Rating and Smoke Density requirements of CBC Section 707.

B. Contractor shall be responsible for providing its workers and subcontractors with the requirements specified in this Section and for subcontractors securing submittal data from vendors.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Clearly identify manufacturer, contents, brand name, and applicable standard.

B. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

C. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

PART 2 - PRODUCTS

2.1 ACOUSTICAL BATTS AND BOARDS

A. Sound-Control Batt: Unfaced, friction fit, preformed slag mineral or glass fiber with thermosetting resin binders, formaldehyde-free, conforming to ASTM C665, Type I; Owens-Corning “EcoTouch QuietZone” by Owens-Corning, or equal.

1. Thicknesses at Wall Cavity: Full thickness.
2. Surface Burning Characteristics: ASTM E84.
   a. Smoke Developed: 50 or less.
   b. Flame Spread: 25 or less.
3. Combustibility: Pass ASTM E136.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas scheduled to receive insulation so as to ensure protection against inclement weather and other hazards and to verify that work of preceding trades is completed.

B. Examine space allocated for insulation for proper depth to receive material.

3.2 INSTALLATION OF ACOUSTICAL INSULATION

A. Install to fill completely all typical and odd spaces in framing where required.

B. Install snugly between framing members. Fit ends snugly between units and against adjacent construction.

C. Carefully cut and fit insulation around pipes, conduit, and other obstructions and penetrations.

D. At doorframes, cut additional strips of insulation, and hand-pack as necessary to fill voids thoroughly.

E. Install glass fiber batt insulation, R=11 minimum, in otherwise uninsulated wall or ceiling cavities containing plumbing pipes.

F. Coordinate sealing with requirements of Section 09 2900, "Gypsum Board."

G. Where sound-insulated walls are fire rated, follow requirements of Section 07 8400, "Firestopping."

H. Prior to closing walls, obtain Architect's observation of insulation installation.

3.3 SOUND ISOLATION

A. Seal sound-insulated partitions airtight with acoustical sealant, in accordance with ASTM C919 and manufacturer's recommendations.

B. Prior to closing walls, allow for observation by the Construction Manager.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Painting and painter's finish on all exposed exterior and interior surfaces, except prefinished items and unless otherwise noted, as required to complete finishing of the Work. The Work includes the following specific items:
   a. Surface preparation, priming and finish coats.
   b. Painting includes field painting of exposed bare and covered pipes (including color coding that may be specified in other sections), hangers, exposed steel and iron support.
   c. Mechanical and electrical items.

B. Items Not Included in This Section:
1. Factory-prefinished items as specified in various Sections.
2. Painting specified elsewhere and included in respective Sections, including but not necessarily limited to shop priming.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00 “Submittal Procedures.”
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00 “Closeout Procedures” and Section 01 78 36 “Warranties.”

1.3 ACTION SUBMITTALS

A. Product Data: A complete list of materials proposed for use, together with manufacturer's technical information, including paint label analysis and application instructions. Information shall be grouped by System using same System identification included in these Specifications.

B. Color Samples:
1. Appropriately label and identify each sample, including location and application. Include Owner’s Representative’s identifying number, manufacturer's name, color number, and gloss units.
2. Gypsum Board: Prepare on gypsum board with specified level of finish, 18 inches square.
3. Wood: Prepare on type and quality of wood specified, 12 inches square.
4. Other Surfaces: Prepare on hardboard, 8 inches square.
5. Each sample shall have stepped finish, clearly showing each coat and build-up of specified finish. Submit separate samples for each required gloss level.
6. Resubmit samples as requested until required sheen, color, and texture are achieved.
7. See also requirements for field samples below.

C. Sustainable Design Requirements:
1. Sustainable Design: Compliance with the California Green Building Standards Code (CALGreen) goals for this Project.

2. Sustainable design submittals are in addition to other submittals.
3. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal.

1.4 INFORMATIONAL SUBMITTALS

A. Statement of applicator qualifications.

B. Claims concerning unsuitability of specified products.

1.5 MAINTENANCE MATERIALS

A. At completion of the Work, deliver to Owner's Representative extra stock of paint of each color used in each coating material used.

B. Containers shall be full, tightly sealed, and clearly marked.

C. Provide the following quantities:
1. Field Colors: One 5-gallon container.
2. Accent Colors: One 1-gallon container.

1.6 QUALITY ASSURANCE

A. Coatings used on interior shall meet Sustainable Design program requirements and shall be Green Seal Standard GS-11 compliant.

B. Unsuitability of Specified Products: Claims concerning unsuitability of any material specified (or inability satisfactorily to produce the Work) will not be entertained, unless such claim is made, in writing, to Owner's Representative before beginning of application.

C. Field Samples:
1. Request review, by the Owner's Representative, of first finished area, room, space, or item of each finish type or color scheme required for color, texture, and workmanship.
2. For wall and ceiling areas, finish a panel 8 feet square.
3. Use first acceptable room, space, or item as the Project standard for each color scheme.

D. Primers:
1. Provide finish coats that are compatible with prime paints used.
2. Review other Sections of these Specifications in which prime paints are to be provided in order to ensure compatibility of total coatings system for various substrates.
3. Upon request, furnish information to other Sections regarding characteristics of finish materials proposed for use.
4. Provide barrier coats over incompatible primers, or remove and re-prime as required.
5. Notify Owner's Representative, in writing, of any anticipated problems arising from using specified coating systems with substrates primed by other Sections.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original, new, unopened packages and containers bearing the manufacturer's name and label and the following information:
1. Name or title of material.
2. Manufacturer's stock number and date of manufacture.
3. Manufacturer's name.
4. Contents by volume for major pigment and vehicle constituents.

5. Thinning instructions.
6. Application instructions.
7. Color name and number.

B. Store materials in tightly covered containers. Maintain containers in a clean condition, free of foreign materials and residue.

C. Store materials at ambient temperature of between 45 degrees F minimum and 90 degrees F maximum, in a well-ventilated area.

D. Ensure that storage area is neat and orderly.

E. Take precautionary measures to prevent fire and health hazards.

F. Comply with additional requirements specified in Section 01 60 00 "Product Requirements."

1.8 FIELD CONDITIONS

A. Ambient Conditions:
1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.
2. Do not apply finish in areas where dust is being generated.
3. Provide lighting level of at least 80 foot-candles, measured mid-height at substrate surface.
4. Provide continuous ventilation and heating to prevent accumulation of hazardous fumes.

B. Protection: Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently or not to be painted.

1.9 WARRANTY

A. Color and Life of Film: The following performance shall be included under the Contractor’s standard Contract guarantee for this Project.
1. Colors of surfaces shall have remained free from serious fading. Variations (if any) shall be uniform.
2. Materials shall have their original adherence. There shall be no evidence of blisters, running, peeling, scaling, chalking, streaks, or stains at end of the guarantee period.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Interior paints and coatings used shall be certified according to the latest “Green Seal Environmental Standard for Paints” (GS-11), Green Seal, Inc.

B. Paint products must comply with the California Green Buildings standards Code (CALGreen) for Paints and Coatings, Section 5.504.4.3.

C. Coatings, primers and undercoats shall satisfy the South Coast Air Quality Management District Rule 1113 for architectural coatings.

D. Sustainable Design:
   1. Sustainable Design: Compliance with the California Green Building Standards Code (CALGreen) goals for this Project.

2.2 MANUFACTURERS AND PRODUCTS

A. Products are specified under "Interior Paint Systems" are manufactured by Behr, Dunn-Edwards, Benjamin Moore & Co. as indicated and the basis of design. Equivalent products manufactured by Sherwin-Williams, PPG Glidden Professional, or equal are acceptable.

B. See the Yolo County Facility Finishes document for manufactures.

C. Materials selected for coating systems for each type surface shall be the product of a single manufacturer or shall be acceptable to manufacturer of finish coating for system.

D. If more than one quality level of product type is marketed, use material of highest quality.

2.3 PERFORMANCE CRITERIA

A. Interior paints and coatings used shall be certified according to the latest “Green Seal Environmental Standard for Paints” (GS-11), Green Seal, Inc.

B. Coatings, primers and undercoats shall satisfy the South Coast Air Quality Management District Rule 1113 for architectural coatings.

2.4 MISCELLANEOUS MATERIALS

A. Cementitious Filler: Nonshrink formulations of white Portland cement with fine silicate aggregate, zinc oxide pigment, and reinforcing chemical binder, as accepted.

B. Spackling Compound: Standard gypsum board compound.

C. Thinner: As recommended by each manufacturer for the respective product.

2.5 COLORS

A. Colors will be selected and provided by the Owner’s Representative. Selected colors may have manufacturer identifications other than from the manufacturers products included in the Paints Systems specified. The listing is solely for the purpose of conveying color information and does not imply waiver of the requirement that all coatings be from the same manufacturer unless a specific system is not available from the primary manufacturer.

B. Submit samples of scheduled and selected colors as specified in Part 1 above. Colors of paints shall match scheduled colors.

2.6 MIXING AND TINTING

A. Deliver paints and stains ready mixed to jobsite.

B. Accomplish job mixing and job tinting only if required for adjustment to finish applied to field test areas to achieve color acceptable to Owner’s Representative.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence, or quality of work and that cannot be put into acceptable condition through preparatory work as included in Article 3.2, "Preparation."

B. Do not proceed with surface preparation or coating application until conditions are suitable.

3.2 PREPARATION

A. General:
1. Broom-clean rooms and spaces before commencement of the work.
2. Verify that surfaces to be painted are dry, clean, smooth, and free from deleterious materials.
3. Protect hardware, nameplates, switch plates, lighting fixtures, stainless steel, aluminum, and other surfaces that are not to be painted by masking, removal, or by other means to ensure a neat job.
4. Locate and install scaffolding and staging so as not to interfere with the work specified in other Sections.

B. Gypsum board shall be prepared and finished for painting as specified in Section 09 29 00 "Gypsum Wallboard Systems."

C. Metals:
1. Remove mill scale, rust, and corrosion.
2. Clean oils, grease, and dust from surfaces.
3. Touch up chipped or abraded areas in shop coatings, using appropriate primer.
4. Soluble Salts: Removal of soluble salts from bare metal and galvanized metal surfaces, both interior and exterior, is required prior to application of primer coats to preclude premature coating failure and accelerated corrosion.
   a. Removal shall be in accordance with SSPC-Guide 15, “Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.”
   b. Abrasive blasting, where specified as a required surface preparation procedure, shall be performed after removal of soluble salts. Abrasive blasting is not an acceptable procedure for removal of soluble salts.

D. Ductwork: Clean visible galvanized portion of ductwork interiors with solvent, and wipe clean.

E. Concrete:
1. Surfaces shall not be painted until they have cured a minimum of 30 days and have as surface pH between 6 and 9.
2. Form release agents, curing compounds, and other concrete treatments must be compatible with the coatings, or be removed.
3. Check for compatibility of coating using a test patch area allowed to dry for one week. Test adhesion in accordance with ASTM D3359.
4. Check for excessive moisture using method specified in ASTM D4263.

F. Surfaces that cannot be prepared or painted to meet the requirements of the coating manufacturer and as specified shall be immediately brought to the attention of the Owner’s Representative, in writing.

1. Starting of work without such notification will be considered acceptance by the Contractor of surfaces involved.
2. Replace unsatisfactory work caused by improper or defective surfaces, as directed by Owner's Representative.

3.3 FACTORY FINISHING AND PRIMING

A. Pertinent Work and Requirements Specified Elsewhere: Review all Sections for products that are to be factory finished or factory (shop) primed.

B. Touch-up: Touch up abrasions in prime coat immediately after products arrive on jobsite and as required prior to application of finish coats.

3.4 APPLICATION

A. Shop-fabricated and finished metal and millwork items shall be shop spray finished to the greatest extent possible.

B. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer.

C. Application:
1. Apply paint with suitable brushes, rollers, or spraying equipment.
2. Stairs, guardrails, steel doorframes, and other exposed metal requiring field finish painting shall be sprayed to the fullest extent conditions will permit. If brush or roller application is used, surface finish shall be subject to review by the Owner's Representative for complying with the appearance requirements specified herein.
3. Apply coatings in accordance with manufacturer's recommendations.
4. Rate of application shall be within limits recommended by paint manufacturer for surface involved.

D. Spray-Gun Application - Standard Coatings:
1. Spray-apply standard paints only with airless sprayer.
2. Apply in fine, even spray, without addition of thinner, using nozzle pattern suitable to surface being painted.
3. When necessary, follow by brushing to ensure uniform coverage and to eliminate wrinkling, blistering, and air holes.
4. If spraying becomes detrimental to equipment or objectionable to personnel, brush painting will be required.

E. Comply with recommendation of product manufacturer for drying time between succeeding coats.

F. Finish coats shall be smooth and free from brush marks, streaks, laps or pileup of paints, and skipped or missed areas.

G. Leave all parts of moldings and trim clean and true to details with no undue amount of paint in corners and depressions.

H. Make edges of paint adjoining other materials or colors clean and sharp, with no overlapping.

I. Refinish whole area where portion of finish is not acceptable.

J. Equipment adjacent to walls shall be disconnected, using workers skilled in appropriate trades, and moved to permit wall surfaces to be painted. Following completion of painting, they shall be expertly replaced and reconnected.

K. Top and bottom edges of doors shall receive same paint system finish required for door faces.

L. Paint visible surfaces behind vents, registers, or grilles flat black.
1. Prepare exposed metal as specified, then prime and paint as scheduled.
2. Spray-paint wherever practicable.

M. Do not paint over fire-rating labels, fusible links, or sprinkler heads.

N. Exposed Plumbing and Mechanical Items: Items without factory finish such as conduits, pipes, access panels, and items of similar nature shall be finished to match adjacent wall and ceiling surfaces, unless otherwise directed.

3.5 CLEANING

A. Touch up and restore finish where damaged.

B. Remove spilled, splashed, or spattered paint from all surfaces.

C. Do not mar surface finish of item being cleaned.

D. Leave storage space clean and in condition required for equivalent spaces in Project.

3.6 PAINT SYSTEMS

A. General:
1. Only major areas are scheduled, but miscellaneous and similar items and areas within room or space shall be treated with suitable system.
2. This Specification shall serve as guide and is meant to establish procedure and quality. Confer with the Owner's Representative to determine exact finish desired.
3. The minimum number of coats are as scheduled. Additional coats shall be applied at no additional cost as required to hide base material completely, produce uniform color, and provide required and satisfactory finish.

B. Surfaces Not to Be Painted:
1. Prefinished wall, ceiling, and floor coverings.
2. Items with factory-applied final finish.
3. Concealed ducts, pipes, and conduit.
4. Surfaces specifically scheduled or noted on the Drawings as not to be painted.

C. Acceptance of Final Colors: Final coat of paint for both exterior and interior shall not be applied until colors have been accepted by the Owner's Representative.

D. Gloss and Sheen Ratings: Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following limits in conformance with Master Painters Institute, Inc. (MPI) Standards according to ASTM D523. Not all of the Gloss Levels are necessarily scheduled or used on this Project.
1. Gloss Level 1: Matte or Flat; not more than 5 units at 60 degrees and 10 units at 85 degrees.
2. Gloss Level 2: Velvet or Low Sheen; not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees.

3. Gloss Level 3: Eggshell; 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
4. Gloss Level 4: Satin; 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
5. Gloss Level 5: Semi-gloss; 35 to 70 units at 60 degrees.

E. Interior and Exterior Painting: As Scheduled on Finish Schedule in Drawings.

3.7 INTERIOR PAINTING SYSTEM

A. Substrates; Various, Typical:
1. Latex System:
a. Prime Coat: Manufacturer's recommended primer for substrate.
1) Dry Film Thickness: 1.5 mils.
b. Intermediate Coat: One coat, latex, interior, matching topcoat.
1) Dry Film Thickness: 1.6 mils.
c. Topcoat: Two coats.
1) Dry Film Thickness: 1.6 mils, per coat.
2. Sheen: Eggshell.

B. Substrates; Wood Doors, Wood Trim, Metal Doors, Metal Trim:
1. Acrylic System:
a. Prime Coat: Manufacturer's recommended primer for substrate.
1) Dry Film Thickness: 2.0 – 4.0 mils
b. Intermediate Coat: One coat, water-based acrylic, interior, matching topcoat.
1) Dry Film Thickness: 2.5 to 4.0 mils
c. Topcoat: Two coats.
1) Dry Film Thickness: 2.5 to 4.0 mils, per coat.
2. Sheen: Semi-Gloss.

3.8 EXTERIOR PAINTING SYSTEM

A. Wood Substrates, Unpainted and Previously Painted (windows, doors trim, typ):
1. Acrylic Latex System: Applied to form dry film thickness of not less than 10 mils.
a. Binding Primer.
b. Prime Coat; one coat.
c. Intermediate Coat: As recommended in writing by topcoat manufacturer.
d. Topcoat: Two coats.
e. Sheen and Color: As indicated on the Finish Schedule.

B. Metal, Galvanized and Ferrous – Unpainted and Previously Painted (gutters, downspouts)
1. Acrylic Latex System: Applied to form dry film thickness of not less than 10 mils.
a. Binding Primer.
b. Prime Coat; one coat.
c. Intermediate Coat: As recommended in writing by topcoat manufacturer.
d. Topcoat: Two coats.
e. Sheen and Color: As indicated on the Finish Schedule.

C. Metal, Galvanized and Ferrous – Unpainted and Previously Painted (handrails):
1. Alkyd System:
a. Prime Coat: Quick-drying primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (semigloss).

D. Window Jambs – Unpainted:

E. Aluminum Substrates:
   1. Alkyd System:
      a. Prime Coat: Quick-drying primer for aluminum.
      b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
      c. Topcoat: Exterior alkyd enamel (semigloss).

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: General requirements for signage as indicated complete with attachment devices and accessories as required for complete installation including:
   1. Code required signage.
   2. Interior permanent room identification signage.
   3. Glass-mounted signage.
   4. Exterior Building and site signage.
   5. Electrical/mechanical equipment room identification.
   6. Luminous egress path markings at interior stairs and other exit enclosures as indicated.
   7. Two-way communication instructions.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
   1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00, “Submittal Procedures.”
   2. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures.” and Section 01 78 36, “Warranties.”

B. Coordination:
   1. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.
   2. Provide vendor and subcontractor with complete and up-to-date Drawings, Specifications, sign schedule, or other items issued by the Owner or Architect.

1.3 ACTION SUBMITTALS

A. Shop Drawings:
   1. Full-scale drawings for each sign indicating materials, lettering layout, and colors.
   2. Large-scale drawing and details of custom logo and lettering. Include mounting details.
      a. Include plans, elevations, and large-scale sections of typical members and other components.
      b. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
   3. Building Floor Plans showing signage location, and numbering where applicable, keyed to Sign Schedule.
   4. Font Styles.
      a. Unless otherwise noted in construction document signage details, submit three proposed samples of signage fonts to be used for visual and tactile characters that are in compliance with 2010 ADA Standard 703.5 and 11B-703.5 California Building Code Title 24 Visual Characters.
      b. Submit 18 point graphical example of alphabet and numerical numbers 0 through 9 of signage font style, 18 point scale, and black text on white paper.

B. Product Data: Furnish manufacturer's literature and indicate each sign type, style, color, and method of attachment.

C. Samples:
1. Unless otherwise noted in construction document signage details, submit three proposed samples of signage fonts to be used for visual and tactile characters. Signage fonts shall comply with 2016 California Building Code Title 24 11B-703.2 tactile Raised Characters and 11B-703.5 Visual Characters.
2. Color Verification and Size: Not less than 6-inches square, and when applicable, include color system name and serial number, code and name as applicable.
3. Control Samples. Samples shall be prepared on same base material to be used in fabrication. Submit one sample of each sign type. Signage types are indicated in Construction Document details. Interior signs shall be full size.
4. Dimensional Letters: One full-size representative samples of each dimensional letter type required, showing letter style, color, and material finish and method of attachment.
5. Symbol of Accessibility Pictograms. Full scale sample of pictograms to be used on sign panels and graphics. Pictograms shall comply with 11B- 703.7 unless otherwise noted on the Construction Drawings.

D. Sign Schedule: Use same designations specified or indicated on Drawings and coordinated with shop drawings.

1.4 QUALITY ASSURANCE

A. Contractor shall assure that the vendor shall be responsible for the quality of materials and workmanship of any firm acting as the vendor's subcontractor.

B. Furnish products of a single manufacturer for each sign type and graphic image processes indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Written Verification of Braille, tactile text and dark to light and light to dark contrasting text and background color approval from Lighthouse for the Blind, San Francisco CA.

1.6 CLOSEOUT

A. Extended warranty.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver signs safely packed to prevent damage during shipment. Package separately or in like groups of names, labeled as to names enclosed; include installation template, attachment system and installation instructions.

B. Comply with additional requirements specified in Section 01 6000, "Product Requirements."

1.8 FIELD CONDITIONS

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

1.9 WARRANTY

A. Contractor: Furnish to the Owner a written extended 5-year guarantee for signage against all defects in materials and workmanship, including without limitation against yellowing, cracking, crazing, and other visible and performance defects.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Regulatory Standards: Except as otherwise specified or shown, signage shall conform to the following:
1. ANSI A-117.1 and the Americans with Disabilities Act (ADA).
2. ATBCB Design Guidelines for Signage in relation to the Americans with Disabilities Act.
3. California Code of Regulations, Titles 19 and 24.
a. California Grade 2 Braille shall be used whenever Braille symbols are specifically required. Refer to CBC Section 1117B.5.2.
b. All signage shall conform to CBC Sections 1111 1115B and 1117B.5.
4. Uniform Sign Code.

B. Design Criteria:
1. Raised Characters: Section 11B-703.2.
a. Letter Type: Section 11B-703.2.1.
1) Raise characters on signs 1/32 inch minimum.
2) Characters shall be sans serif uppercase characters accompanied by Grade 2 Braille.
b. Character Size: Section 11B-703.2.5.
1) Raised characters shall be a minimum of 5/8 inch and a maximum of 2 inches high.
c. Proportions of Letters and Numbers: Section 11B703.2.4.
1) Characters on signs shall have a width-to-height ratio of between 3:5 and 1:1 and a stroke width-to-height ratio of between 1:5 and 1:10.
d. Letters measured to verify compliance must be uppercase.
1) After choosing a typestyle to test, begin by printing the letters I, X, and O at 1 inch high.
2) Place the template’s 1:1 square over the X or O, whichever is narrower. If the character is not wider than 1 inch, nor narrower than the 3:5 rectangle, the proportions are correct.
3) Use the 1:5 rectangle to determine if the stroke of the I is too broad, and the 1:10 rectangle to see if it is too narrow.
4) If the tests are passed, the typestyle is compliant with proportion code.
2. Braille Symbols: Section 11B-703.3.
a. California Contracted Grade 2 Braille with rounded or domed dots shall be used wherever Braille is required. Dots with straight sides and flat tops are not readable for many Braille users and are not acceptable.
b. Space dots 1/10 inch on center in each cell with 2/10 inch space between cells, measured from the second column of dots in the first cell to the first column of dots in the second cell.
c. Raise dots a minimum of 1/40 inch above the background.
d. Installation Height: 11B-703.4.
3. Pictograms: Section 11B-703.6.
a. Field: 6” high. Characters and Braille shall not be located in the pictogram field, 11B-703.6.1.

b. Text Descriptors: Locate text descriptors directly below the pictogram field.
4. International Symbol of Accessibility: Section 11B-703.7.2.1 and figure 11B- 703.7.2.1.
5. Contrast and Finish of Symbols: Section 11B-703.6.2.
   a. Contrast between character, symbols and their background must be 70 percent minimum and have a non-glare finish.
6. Mounting Height and Location: Signs with tactile characters shall comply with Section 11B-703.4.
7. Doorways Leading to Sanitary Facilities: Provide Signs that Comply with Applicable Requirements of Sections 11B-703.7.2.6.
8. Grade Level Exterior Exit Doors: Provide tactile exit signage to comply with 1011.1 and 11B-703.4.2.

2.2 MATERIALS

A. General: To be finalized by Architect.

2.3 INTERIOR SIGNS

A. Toilet Room Identification:
   1. General:
      a. Fabrication: Laminated colored plastic, 1/4 inch thick, core color contrasting with exterior face color and texture; or acrylic plastic with inset symbols.

2.4 GRAPHIC LAYOUTS

A. Text and Layouts: Copy as indicated on the Drawings; To be finalized by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, examine site to confirm that all sign locations are as specified and are ready for installation.

3.2 INSTALLATION

A. General:
   1. Use concealed mounting in compliance with manufacturer's instructions.
   2. Install signs level and plumb at height indicated, with sign surfaces free from distortion or other defects in appearance.
   3. Locate signage where shown and scheduled. Where location is not shown, locate as directed by Architect or required by code.

B. Plaques: Mount to wall and door surfaces with specified mounting tape.
   1. Mounting Height: 60 inches above floor, unless otherwise shown, specified, or required by code.
   2. Door-Mounted Signs: Center on door.
   3. Wall-Mounted Signs: Mount on latch side of door, except as otherwise shown or specified.

C. Dimensional Characters: Mount characters using pins recommended in writing by manufacturer for character form, type of mounting, wall construction, and condition of exposure indicated.

1. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
2. Pins shall be of sufficient length for letters to project 1-1/2 inches from wall and with 1/2-inch clearance to wall surface.

3.3 CLEANING AND PROTECTION

A. At completion of installation, clean soiled surfaces in accordance with the manufacturer's instructions.

B. Protect signage from damage until acceptance by Owner.

END OF SECTION

SECTION 10 26 12

WALL PROTECTION AND CORNER GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: The following types of wall protection systems:
1. High-impact vinyl/acrylic wainscoting.
2. Solid surface wall covering.
3. Resilient corner guards, mounting hardware, and accessories.
4. Flexible wall protection.

B. Related Requirements:
1. Impact Resistive PETG Clad Wood Doors: Section 08 14 23.
2. Non-Structural Metal Framing: Section 09 2216; backing plates.
3. Gypsum Board: Section 09 29 00:
4. Resilient Flooring and Base: Section 09 65 00:

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action Submittals shall be submitted in accordance with Section 01 33 00 “Submittal Procedures.”
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00 “Closeout Procedures” and Section 01 78 36 “Warranties.”

B. Coordinate with Section 09 22 16 "Non-Structural Metal Framing" and Section 09 29 00 "Gypsum Board" for scheduling of installation and interface with supporting and adjoining system.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's catalog cuts and data sheets, including installation details and instructions, for each item specified.

B. Samples:
1. Initial Samples: Complete chart of manufacturer's available colors for selection by the Owner Representative.
2. Verification Samples:
a. 6-inch section long section of crash rail in selected color. Include mounting and end cap.
b. 6-inch-square samples of high-impact wall covering in selected color.

C. Sustainable Design Requirements:
1. Submit information necessary to establish and document compliance.

1.4 INFORMATIONAL SUBMITTALS

A. Quality Control: Manufacturer's certification that PETG products meet specified physical and performance requirements. Results of tests specified shall accompany certification.

1.5 QUALITY ASSURANCE

A. Mockups: First installed example of each product shall serve as a mockup for review by the Owner Representative of workmanship, installation, and visual effect.
1. Coordinate location of mockup with the Owner Representative.
2. Make modifications when requested.
3. Accepted mockups may remain as part of completed work.
4. Comply with additional requirements of Section 01 43 39 "Mockup Requirements."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store materials in manufacturer's original, unopened packages, clearly identified with manufacturer's name, brand name, quality or grade, and fire hazard classification.

B. Store materials between 45 and 85 degrees F.

C. Comply with additional requirements specified in Section 01 60 00 "Product Requirements."

1.7 FIELD CONDITIONS

A. Store materials in area of application; allow three days for material to reach same temperature as area.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Engineered Polyethylene Terephthalate Glycol (PETG) Material: PVC-free and meeting the following additional criteria.
1. Flammability: Engineered PETG material shall have Class 1 rating (flame spread of 25) in accordance with Tunnel Test ASTM E84.
2. Attachments shall support minimum 50 pounds per lineal foot and minimum 250 pound point load at any point without permanent deflection.
3. Impact Strength: Provide assembled wall protection units that have been tested in accordance with the applicable provisions of ASTM F476.
4. Chemical and Stain Resistance: Provide wall protection system components with chemical and stain resistance in accordance with ASTM D 1308.
5. Color match: Provide wall protection components that are color matched in accordance with the following:
a. Delta Ecmc of no greater than 1.0 using CIELab color space.

B. Solid Surfacing (Modified Acrylic Polymer):
1. Fire Resistance: Testing in accordance with ASTM E84
a. Flammability: Class 1
b. Flame Spread Index: Less than 25
c. Smoke Developed Index: Less than 25.
2. Bacterial Resistance: No observed growth at 100x power when tested in accordance with ASTM G22.
3. Microbial Resistance: Highly resistant to mold growth when tested in accordance with ASTM D6329.
4. Cleanability and Stain Resistance: Pass when tested in accordance with IAPMO Z124-2011.

C. Single Source Responsibility: Provide all components of the wall protection system manufactured by the same company to ensure compatibility of color, texture and physical properties.

2.2 MANUFACTURED WALL CLADDING AND PROTECTION

A. (WC-1) Solid-Surface Wall Panel: Semi rigid, acrylic polymer and alumina trihydrate (ATH) panel; (TBD by architect)
1. Panel Thickness: 1/4 inch (6mm).
2. Panel Face Dimensions: As scheduled on the Drawings unless otherwise available from manufacturer to minimum joints.
3. Color: (TBD)

B. (WC-2) Crash Rail: Surface-mounted, high impact cover snapped in place over a continuous aluminum retainer on bumper cushions; “Acrovyn” Model SCR-48MN by Construction Specialties, Inc., or equal.
1. Height: 6 inches.
2. Color: (TBD)

PART 3 - EXECUTION

3.1 EXAMINATION

A. After finish painting of walls is complete, examine areas and conditions under which each wall protection products is to be installed.

3.2 INSTALLATION

A. General: Install products in accordance with manufacturer's installation instructions and as shown on the Drawings, to match accepted mockups.

3.3 ADJUSTMENT AND CLEANING

A. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items removed prior to installation of wall protection.

B. Prior to time of final acceptance, strip protective coverings where provided by manufacturer, and clean in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10 28 13

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Toilet accessories.
   2. Janitorial accessories.

B. Related Requirements:
   1. Joint Sealants: Section 07 92 00.
   2. Non-Structural Metal Framing: Section 09 22 16; metal backing plates.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
   1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00, “Submittal Procedures.”
   2. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures,” and Section 01 78 36, “Warranties.”

B. Coordination:
   1. Coordinate submission of installation instructions so backing, blocking, and framing can be properly installed and work of other trades will not be delayed.
   2. Coordinate accessory locations with other work to avoid interference and to ensure proper operation and servicing of accessory units.

1.3 ACTION SUBMITTALS

A. Schedule and Shop Drawings: Indicate type, quantities, sizes, and locations for accessories.

B. Product Data: Manufacturer's catalog cuts and data sheets.

C. Samples: Full size of an accessory, if requested. Samples, if submitted, will be returned, and acceptable samples may be used in the work.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data and operating instructions.

B. Keys required for each type of equipment and lock.

C. Extended warranties as specified.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Meet applicable requirements of Americans with Disabilities Act (ADA) and CBC for accessibility. When in conflict, comply with the most stringent.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials in original packaging to prevent soiling, physical damage, or wetting.

B. Protection:
1. Maintain protective covers until installation is complete.
2. Remove protective covers at final cleanup of installation.

C. Comply with additional requirements specified in Section 01 60 00, "Product Requirements."

1.7 WARRANTY

A. Manufacturer: Furnish to Owner a manufacturer’s written guarantee for mirrors against silver spoilage and all other defects in materials for 5-years from date of acceptance.

PART 2 - PRODUCTS

2.1 CONTRACTOR FURNISHED AND INSTALLED ACCESSORIES

A. Toilet Accessories (“RA”): Refer to Restroom Accessory Schedule on Drawings.

2.2 JANITORIAL ACCESSORIES AND ADDITIONAL ITEMS

A. Surface-Mounted Stainless Steel Utility Shelf with Mop/Broom Holders and Hooks: B-239.

B. Pipe Wrap at Exposed Undercounter Plumbing: Flexible vinyl; “Lav-Guard 2" by Truebro Inc., Collierville, TN, 800-340-5969, or accepted equal.
1. Series: As recommended by manufacturer for pipe trap type.
2. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check substrates and recesses for correct dimensions, plumbness of blocking or frames, and preparation and also other conditions that would affect installation of accessories.

B. Verify spacing of plumbing fixtures and toilet partitions that affect installation of accessories.

3.2 INSTALLATION

A. General:
1. Install accessories in locations and at heights indicated on the Drawings.
2. Install accessories in accordance with manufacturer's recommendations and code accessibility requirements, plumb, true to line, complete with all required fasteners and accessories, securely anchored to backing, blocking, or building structure.
3. Drill holes to correct size. Cut openings for recessed items with 1/4-inch tolerance so that cut is concealed by flange after application of item.
4. Mount recessed accessories into wall openings with wood screws through cabinet side into wood blocking or sheet metal screws into metal blocking or backing.
5. Mount surface-mounted accessories to solid backing or blocking; plumb and align.

B. Sealants: Comply with requirements of Section 07 92 00, “Joint Sealants.”
   1. Apply behind toilet accessories as necessary to ensure sanitary and watertight integrity of surfaces.
   2. Conceal sealants.

C. Framed Mirrors: Secure to concealed wall hanger in accordance with manufacturer's instructions for theft-resistant mounting. Seal channel to mirror with sealant.

D. Attach grab bars to backing installed in walls to withstand loads prescribed by CBC.

3.3 ADJUSTMENT AND CLEANING

A. Remove protective coverings in accordance with manufacturer's instructions.

B. Adjust accessories for proper operation.

C. After completion of installation, clean and polish exposed surfaces.

D. Deliver keys and instruction sheets to Owner.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Salvage existing Fire extinguisher cabinets and reuse.
2. Combination fire extinguisher and fire hose cabinets.
3. Fire extinguisher mounting brackets.

B. Related Requirements:
1. Fire Protection: Division 21.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action Submittals shall be submitted in accordance with Section 01 33 00 “Submittal Procedures.”
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00 “Closeout Procedures” and Section 01 78 36 “Warranties.”

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's specifications and installation instructions for fire extinguishers and cabinets to be used.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data for fire extinguishers to include in maintenance manuals.

B. Guarantee Warranty as specified.

1.5 QUALITY ASSURANCE

A. Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

B. Fire extinguishers shall be listed and labeled for type, rating, and classification by Factory Mutual Global (FMG) or another independent testing agency acceptable to authorities having jurisdiction and to the Owner's insurance carrier.

C. Meet “ADA Standards for Accessible Design” requirements for mounting height and projection from wall.

D. Fire Extinguishing Agent: Provide clean agent which does not contain halons or HCFCs.

1.6 WARRANTY

A. Manufacturer: Furnish Owner with manufacturer's 6-year written warranty in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period. Failure includes, but is not limited to, the following:
   1. Failure of hydrostatic test according to NFPA 10.
   2. Faulty operation of valves or release levers.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Fire Extinguishers: Multipurpose dry chemical type as furnished by Contractor.

B. Semi-Recessed Fire-Rated Fire Extinguisher Cabinets: Larsen's "Architectural" Series as specified and basis of design, JL Industries, or equal.
   1. Model: FS-2712-RK, inside dimensions 12 inches wide x 27 inches high x 8 inches deep.
   2. Trim Style and Projection: Semi-Recessed 1-1/4 inch.
   3. Door Style: "Vertical Duo" with clear acrylic pane.
   4. Hinge: Continuous piano type to match cabinet.
   5. Latching Device: Steel cam lock-based design to permit opening of the cabinet door by pulling sharply on the handle; "Larsen-Loc" or equal.
   6. Finish: Stainless steel.
   7. Lettering: Die cut black letters reading "FIRE EXTINGUISHER," meeting CBC requirements, and applied vertically.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install re-used cabinets and extinguishers where indicated on the Drawings and as required by the WFD.

B. Install fire-rated cabinets in rated walls as required to maintain fire separation integrity of partition.

C. Securely fasten to structure, square and plumb, in accordance with manufacturer's instructions.

D. Wherever exact location of units is not shown, locate as directed by the Owner Representative.
   1. Provide specified mounting brackets for extinguishers not located in cabinets.
   2. Secure to mounting surface in accordance with manufacturer's instructions.
   3. Install Owner-furnished fire extinguisher in each cabinet and at each mounting bracket.

E. Determine the date of Substantial Completion of the Work. Inspect, charge, and tag the Owner-furnished fire extinguishers within 10 days before the Substantial Completion date.

END OF SECTION

SECTION 10 51 13

METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Double tier metal lockers.
2. Locker accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action Submittals shall be submitted in accordance with Section 01 33 00, "Submittal Procedures."
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures,” and Section 01 78 36, “Warranties.”

1.3 ACTION SUBMITTALS

A. Shop Drawings: Submit layout and dimensions for each bank of metal lockers.
1. Indicate relationship to adjoining surfaces.
2. Show locker elevations and details, fillers, trim, base, sloping tops, and accessories. Include locker numbering sequence.
3. Indicate installation and anchorage requirements.
4. Identify accessible locker locations.

B. Product Data: Manufacturer's printed data including materials, accessories, construction, finishes, assembly, and installation instructions for lockers.

C. Samples:
1. 6 inch-square sample of metal in selected color.
2. Samples of handles and other accessories, if requested by Architect.

1.4 CLOSE OUT SUBMITTALS

A. Extended warranties.

B. Maintenance Instructions: Instructions for cleaning lockers and for adjusting, repairing, and replacing locker doors and latching mechanisms.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain locker units and accessories from one manufacturer.

B. Regulatory Requirements: Comply with accessibility requirements of SFBC and ADA “Standards for Accessible Design” and the following. Where there is a conflict between these regulations, comply with the most stringent.
1. Provide not less than one shelf located within required reach ranges.

2. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver lockers until spaces to receive them are clean, dry, and ready for locker installation.

B. Protect lockers from damage during delivery, handling, storage, and installation.

C. Comply with additional requirements specified in Section 01 60 00, "Product Requirements."

1.7 WARRANTY

A. Manufacturer: Furnish to Owner manufacturer’s 2-year written warranty for lockers to be free from defects in material or factory workmanship.

PART 2 - PRODUCTS

2.1 METAL LOCKERS

A. Wardrobe Lockers: Knock-down type; Sentinel “Gear Locker”or accepted equal.
1. Type: Footlocker, One-compartment, 1 shelf, 24 inches wide by 36 inches deep by 90 inches high.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install metal lockers complete with accessories according to manufacturer's recommendations. Install plumb, level, rigid, and flush.

B. Connect together welded locker groups with standard fasteners according to manufacturer's recommendations, with no exposed fasteners on face frames.

C. Anchor lockers to floors and walls at intervals recommended by manufacturer but no greater than 36 inches. Install anchors through back-up reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

D. Install finished end panels to conceal exposed ends of non-recessed lockers.

3.2 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

B. Clean interior and exposed exterior surfaces and polish stainless-steel and nonferrous metal surfaces.

C. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.

D. Touch up marred finishes, or replace locker units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 11 31 00

RESIDENTIAL APPLIANCES AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Residential grade appliances.

B. Requirements for equipment which is:
   1. Owner Furnished, Owner Installed (OFOI).
   2. Owner Furnished, Contractor Installed (OFCI).
   3. Contractor Furnished, Contractor Installed (CFCI).

C. Related Requirements:
   1. Architectural Wood Casework: Section 06 41 00.
   2. Solid Surfacing Countertops: Section 12 36 61.
   3. Rough-in and Connection of Mechanical and Electrical Services as Required for Operation: D Requirements for equipment which is:
   4. Divisions 22 and 26.
   5. Appliance Schedule on Drawings.

1.2 COORDINATION

A. Coordinate sequence of installation with work of other Sections including casework and placement of utility stub-outs and shut-off valves.

B. Coordinate fabrication of custom face panels with cabinetwork specified in Section 06 41 00, “Architectural Wood Casework.”

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's catalog cuts of equipment with model numbers and optional accessories to be provided clearly marked.

1.4 CLOSEOUT SUBMITTALS

A. Manufacturer's guarantee and warranty certificates, manufacturer's Owner’s Manuals including operating and maintenance instructions, and all other documentation included in packaging by manufacturer.

1.5 WARRANTY

A. Warranty: Furnish written 1-year factory warranty for repair of any defect in appliances without cost to the Owner.

B. Service: Provide any required servicing on appliances for period of 3 months after installation during regular working days at no cost to the Owner.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Where applicable, equipment shall conform with NSF (National Sanitation Foundation) and UL (Underwriters' Laboratories requirements) and shall bear appropriate NSF and UL labels. Appliances, where applicable, shall be ADA compliant.

2.2 EQUIPMENT SUMMARY

A. Project design is based on materials and systems of manufacturers scheduled. Products of other manufacturers will be considered for substitution subject to compliance with the requirements of Section 01 60 00 “Product Requirements.”

B. Detailed Specifications for equipment consists of manufacturer's descriptions, cuts, and drawings on file in the office of the Owner Representative and supplement this Specification by reference.

C. Contract status or responsibility for individual items of equipment listed elsewhere is defined by symbol for each item. Explanation of symbols is listed herein. Where any mechanical or electrical service is required, comply with the requirements of applicable Sections in Divisions 22, 23, and 26.
1. Equipment specified shall conform to the requirements of the Mechanical and Electrical Sections.
2. For Owner-Furnished Contractor Installed (OFCI) items, rough-in dimensions and characteristics will be made available to the Contractor upon request.
3. In the event that Owner substitutes an item similar to that listed elsewhere, Contractor shall not be due any extra rough-in cost, unless substitution occurs after utilities or other provisions not required by original item specified.

D. Owner Furnished Contractor Installed (OFCI) items furnished by Owner and installed by Contractor.
1. Contractor shall:
a. Furnish and install any necessary backing for the installation.
b. Coordinate delivery and receipt of items to the site.
c. If required, coordinate with Owner and store items until ready for installation.
d. Coordinate the installation of items as shown, in accordance with the manufacturer's recommendations, instructions and shop drawings, as applicable, under supervision of manufacturer's representative.
e. Direct and supervise the final connection of the items by the Mechanical and Electrical Contractors.

E. Contractor Furnished Contractor Installed (CFCI) items. Some equipment items for this Project are CFCI and include the following requirements.
1. Contractor Shall:
a. Furnish and install any necessary support and backing for the installation.
b. Coordinate delivery of items to the site.
c. Receive items at site.
d. Store items in a safe and dry location until ready for installation.
e. Uncrate, assemble and set items in place.
f. Install items as shown, in accordance with the manufacturer's recommendations, instructions and shop drawings (as applicable) under supervision of manufacturer's representative.

g. Direct and supervise the final connection of the items by the Mechanical and Electrical Contractors.

F. Owner Furnished Owner Installed (OFOI) items furnished by Owner and installed by Owner.
1. Contractor Shall:
a. Furnish and install any necessary backing for the installation.
b. If required, coordinate with Owner and store items until ready for installation.
c. Coordinate the installation of items as shown, in accordance with the manufacturer's recommendations, instructions and shop drawings, as applicable, under supervision of manufacturer's representative.
d. Direct and supervise the final connection of the items by the Mechanical and Electrical Contractors.

2.3 APPLIANCES AND EQUIPMENT

A. General:
1. Dimensions specified, and utility requirements, shall be verified with manufacturer for each Model.
2. Additional utility requirements for each item are shown on the Drawings and specified in Division 22, “Plumbing,” Division 23, “Ventilating and Air Conditioning,” and Division 26, “Electrical.”

B. Appliances (CFCI): As specified on Drawings.
1. Residential Dishwasher: Model GDT225SSLSS ADA Compliant Stainless Steel by GE.
2. Residential Refrigerator: Model GNE27JYMFS 27.0 Cu. Ft. French-D.
3. Residential Microwave: Model GCST16S1WSS 1.6 Cu. Ft. Microwave by GE.
4. Residential Range: Model JS645EL/SL/FL/DL 30” Slide-in Electric Range by GE.
5. Commercial Style Hood: Model UVW93042PSS ADA Compliant by GE.

C. All newly installed appliances shall meet the following requirements:

Appliance	**Requirement**
Residential Refrigerator	GE ENERGY STAR
Residential Dishwasher	GE ENERGY STAR
Residential Microwave	ENERGY STAR
Residential Oven 30”	GE JS45EL”
Residential Range 30”	GE

2.4 INSTALLATION

A. Locate utilities in accordance with appliance layout shown and connection locations on each appliance and item of equipment.

B. Connection materials and their installation, not typically included as part of an appliance installer’s scope of work and required for the proper installation and operation of the appliances, shall be included as part of the Work of this Contract. Insulate sufficiently to prevent electrolysis between dissimilar metals.

C. Provide shut-off valves, electrical outlets, capped exhaust ducts, and other items for operation of equipment in accordance with manufacturer's instructions, governing authorities, as shown, and specified.

D. Adjust installed equipment to operate in manner satisfactory to Architect.

END OF SECTION

SECTION 12 21 13

HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Include:
1. Manual operated horizontal aluminum blinds.

B. Related Requirements:
1. Mockups: Section 01 43 39.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00, “Submittal Procedures.”
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00, “Closeout Procedures.” and Section 01 78 36, “Warranties.”

B. Coordinate with window Sections for proper fit of blinds to window openings. Make field measurements as required.

1.3 ACTION SUBMITTALS

A. Schedule and Shop Drawings: Provide and show the following:
1. Field-measured dimensions of openings scheduled to receive blinds using same room designations indicated on the Drawings. Include plan diagrams showing divisions across opening.
2. Illustrations of special accessory components not included in manufacturer's products data.
3. Details of head and sill conditions, corner conditions, and conditions between adjacent blind units.
4. Location of controls for each blind.

B. Product Data: Manufacturer's descriptive literature and installation instructions for each type of blind used.

C. Samples:
1. 6-inch section of slats indicating available full color range and color variations.
2. One complete blind in color selected, complete with controls and accessories.
3. Valance: Full-size unit, not less than 12 inches wide.

1.4 INFORMATIONAL SUBMITTALS

A. Statement of installer qualifications.

B. Mockup as specified.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data for horizontal louver blinds to include in the operation and maintenance manual. Include the following:
   1. Methods for maintaining horizontal louver blinds and finishes.
   2. Precautions for cleaning materials and methods that could be detrimental to finishes and performance.
   3. Operating hardware.

B. Extended warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Verifiable experience in the proper installation of horizontal louver blind systems and approved by the manufacturer.

B. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.

D. Provide horizontal louver blinds complying with WCMA A100.1.

E. Mockup:
   1. First installed window blinds shall serve as a mock-up for review by Architect and Owner of installation workmanship, visual effect, operation, and interface with adjacent construction.
   2. Locate at opening as selected in coordination with the Architect.
   3. Adjust and modify installation as requested.
   4. Accepted mock-up may remain as part of finished construction if in good condition and acceptable to the Architect.

1.7 FIELD CONDITIONS

A. Field Measurements:
   1. Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on shop drawings.
   2. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies.
   3. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 WARRANTY

A. Manufacturer: Provide Owner with manufacturer’s lifetime warranty for blinds.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Horizontal Blinds: Model “Everwood” Faux Wood Blinds by Hunter Douglas Corporation as specified and the basis of design, or equal.

B. Maximum blind width shall be 60-inches.

C. All products, including hardware, accessories, mounting brackets, and fastenings, shall be from one manufacturer.

2.2 DESIGN AND PERFORMANCE CRITERIA

A. Length of operating devices shall be sufficient for easy operation from a convenient position and shall meet applicable handicapped regulations. Bottom of control rods shall be not more than 42 inches above finish floor.

B. Divisions between blinds shall occur only at mullions of continuous windows or openings where more than one blind for one opening occurs.

2.3 MATERIALS

A. Slats: Spring-tempered prefinished aluminum with manufacturing burrs removed and radiused corners.
   1. Thickness: Nominal 0.008.
   2. Slat Width: 1 inch, nominal.

B. Slat Support: Woven polypropylene, ladder configuration.
   1. Size and rung spacing to match slats.

C. Headrail Housing: Prefinished, formed-steel "U" channel, internally fitted with hardware, pulleys, and bearings for blind operation.
   1. Size: 1-inch high by 1-9/16 inch wide.
   2. Thickness: 0.025 inch.
   3. Cross braced for rigidity.

D. Bottom Rail: Prefinished, formed-steel box with manufacturer's standard top surface contoured to match slat.
   1. Reinforce to prevent twisting or sagging.
   2. Provide with matching end caps.

E. Lift Cord: Braided polyester/rayon, continuous loop, free end of sufficient length to control raising and lowering of blind.
   1. Location: Right side, typical.
   2. Color: To match color of blinds.

F. Cord Lock: Steel, securely attached to headrail, and crash proof type with sufficient sensitivity to lock slats at desired height upon release of cord.

G. Tilter: Manufacturer's steel enclosed self-lubricating nylon, automatically disengaging worm and gear mechanism to provide maximum closure, eliminate overdrive, and prevent strain or damage to bling.
   1. Worm-and-gear drive actuated by specified wand.

2. Location: Left side, typical.

H. Control Wand: Extruded clear hollow plastic with round fluted cross section approximately 5/16 inch in diameter, removable type.
1. Length shall be sufficient for easy operation from a convenient position and meet required ADA Standards for Accessible Design.
2. Guidelines accessibility regulations.

I. Equalizers: Self-aligning, nylon, designed to maintain blind slats in horizontal position.

J. Accessory Hardware:
1. Pocket-type hinged mounting brackets.
2. Intermediate brackets for blinds exceeding 60 inches in width.
3. Two hold-down brackets at sill, color to match slats.
4. Manufacturer's standard valance and valance clips.
5. Provide additional items as recommended by blind manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and openings are ready to receive the work.

B. Ensure structural supports and backing are correctly placed.

C. Verify that field measurements are as shown on reviewed submittals.

3.2 INSTALLATION

A. Windows to receive blinds are indicated on the Drawings.

B. Install blinds in accordance with manufacturer's installation procedures and reviewed submittals, to match accepted mockup.

C. Mounting shall be between jambs, unless necessary to be face installed. Provide 1/4 inch clear from each side of window opening and located so that exterior louver edges in any position are not closer than 1 inch to interior face of glass lites.

D. Position units plumb and true, and securely anchor in place with brackets, clips, and fasteners.

E. Divisions between blinds, where required, shall occur only at mullions.

F. Install intermediate support brackets and extension brackets as needed to prevent deflection in headrail.

3.3 ADJUSTING

A. Adjust blinds to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING

A. Clean blind surfaces after installation, according to manufacturer's written instructions.

B. To ensure proper drying after cleaning, provide adequate ventilation, remove bottom rail plastic end caps, and tip headrail and bottom rail to drain water.

C. Replace damaged blinds that cannot be repaired, in a manner approved by Architect.

END OF SECTION

SECTION 12 36 61

SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Non-porous solid surfacing consisting of natural minerals and acrylic polymer, filler, and pigments for countertops, splashes, and vertical surfaces of casework:
   a. Natural crushed quartz aggregate combined with polymer resins and pigments.
   b. Natural minerals and acrylic polymer, filler, and pigments.
2. Integral sinks of acrylic polymer.

B. Related Requirements:
1. Metal Specialties: Section 05 59 00; countertop support brackets.
2. Miscellaneous Rough Carpentry: Section 06 10 53; rough support framing; countertop support brackets.
3. Architectural Wood Casework: Section 06 41 00.
4. Joint Sealants: Section 07 92 00.
5. Plumbing: Division 22.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:
1. Action and Informational Submittals shall be submitted in accordance with Section 01 33 00 “Submittal Procedures.”
2. Closeout Submittals shall be submitted in accordance with Section 01 77 00 “Closeout Procedures” and Section 01 78 36 “Warranties.”

1.3 ACTION SUBMITTALS

A. Shop Drawings:
1. Dimensioned, to-scale plans and elevations showing details of fabrication, seams, edging, sink installation, fastener types and locations, sealant, and method of attachment.
2. Identify color and pattern of solid surfacing for each location and type.
3. Coordinate preparation of shop drawings with casework interfacing with solid surfacing countertops.

B. Product Data: Manufacturer’s descriptive literature and test reports substantiating that solid surfacing meets specified requirements.

C. Samples:
1. Minimum 6-inch-square piece of each pattern and color.
2. Counter edge, 6-inches long, in required profile.

1.4 INFORMATIONAL SUBMITTALS

A. Statement of fabricator qualifications.

B. Evidence of certification of installer by manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Extended warranty.

B. Manufacturer's recommended care and maintenance recommendations including recommended repair and cleaning instructions.

1.6 QUALITY ASSURANCE

A. Fabricator/Installer Qualifications: Certified by manufacturer of solid surfacing as an acceptable fabricator and installer.

B. Mockup:

C. First installed countertop assembly, to include sink and backsplash, shall serve as a mockup for review by Owner’s Representative of workmanship, visual effect, and interface with adjacent construction.

D. Coordinate with other Sections for a complete installation.
1. Comply with additional requirements of Section 01 43 39 "Mockup Requirements."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver products until wet work, painting, and similar operations in storage and installation areas which could damage or soil work have been completed.

B. Store in racks in near-vertical position away and from direct exposure to sun. Store with finished face toward finished face.

C. Comply with additional requirements specified in Section 01 60 00 "Product Requirements."

1.8 WARRANTY

A. Manufacturer: Furnish Owner with manufacturer's extended 10-year warranty against defects in materials, fabrication, and installation. Warranty shall provide material and labor to repair or replace defective materials.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Flammability: Provide solid surfacing with the following Class A (Class I) surface burning characteristics as determined by testing identical products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame Spread Index: 25 or less.
2. Smoke Developed Index: 450 or less.

B. Solid surfacing materials shall conform to ANSI/CPA SS-1.

C. Integral sink shall comply with APMO Z124.

2.2 MATERIALS

A. Solid Surfacing Type CW-1 – Typical, laminated countertop by “Formica” as specified and the basis of design, or equal.
   1. Thickness:
      a. Countertop: 1/2 inch.
      b. Solid Surfacing (Break Room).
      c. Vertical Surfaces: 1/4 inch.
   2. Color and Pattern: Bleached Concrete - As indicated on Finish Schedule. Before ordering verify with Owner’s Representative that color selections and edge detail have been finalized.

2.3 ACCESSORIES

A. Mounting Adhesive: Structural-grade silicone or epoxy of type recommended by manufacturer for application and conditions of use.

B. Panel Joint Adhesive: Manufacturer's standard two-part epoxy or polyester to create flush, inconspicuous, monolithic, non-porous joints with a chemical bond.

C. Sealant: Silicone; type as recommended by solid surfacing manufacturer.

D. Mounting Hardware:
   1. Fixtures: Manufacturer's approved bowl clips, brass inserts, and fasteners.
   2. Surfacing: Type and size as required and recommended by surfacing manufacturer.

2.4 FABRICATION

A. General:
   1. Comply with applicable requirements of ISSFA-2 and printed instructions of manufacturer including those for treating cut edges, sanding, polishing, seaming and layering.
   2. Install integral sinks in countertops in the shop.
   3. Obtain field measurements, and verify dimensions before fabricating work.

B. Fabricate to dimensions, profiles, and details indicated on the Drawings.
   1. Use a single piece wherever possible. Where multiple sheets are required, use sheets in consecutive order as numbered by manufacturer.
   2. Precut openings for applied fixtures and fittings, where possible.
      a. Cutouts shall be smooth and uniform without saw marks.
      b. Make cutouts for fixtures and sinks using template or pattern furnished by respective manufacturer.
   3. Predrill mountings for applied hardware, where possible.
   4. Conceal all fasteners.

C. To greatest extent possible, complete fabrication and assembly before shipment to site.
   1. Disassemble components only as necessary for shipment and installation.
   2. Where necessary for fitting at site, provide extra borders and edges to allow scribing and trimming to fit.

D. Provide joints only where maximum available lengths or countertop configuration requires a joint.
   1. Install joints where shown on reviewed shop drawings, in accordance with manufacturer's instructions.

2. Do not locate joints within 18 inches of a sink and not where a countertop section less than 36 inches long would result, unless unavoidable
3. Joints shall be hard seamed. Provide 2-inch-wide seam blocks under seams in accordance with manufacturer's recommendations.
4. Seal seams with specified joint adhesive, clamp tightly, and sand smooth.
5. Finished joints shall be flush, monolithic, uniform, and nearly invisible.

E. Fabricate countertops with integral front edge with profile shown on the Drawings, and with small-radius coved back and end splashes.

F. Allowable Tolerances:
1. Variation in Component Size: Plus or minus 1/4 inch.
2. Location of Openings: Plus or minus 1/4 inch from indicated position.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that backing has been installed at appropriate locations for anchorage.

B. Examine shop-fabricated work for completion. Complete work as required.

3.2 INSTALLATION

A. Install countertops conforming to manufacturers recommended installation procedures, as shown on reviewed submittals, to match accepted mockup.
1. Set tops on supports.
2. Anchor using fasteners shown on reviewed shop drawings.

B. If field joints are required, make them in same manner as shop joints. Finished joints shall be flush, monolithic, uniform, and nearly invisible.

C. Scribe and cut to fit adjoining work.

D. Install work plumb, level, true, and straight, with no distortions. Install with no variation in flushness of adjoining surfaces. Shim as required, using concealed shims.

E. Sealant: Use silicone sealant to attach back and end splashes, and to seal joints around plumbing fixtures.

F. Install sealant as specified in Section 07 92 00 "Joint Sealants" as required to close any small unavoidable gaps between counter and abutting surfaces. Sealant shall not be used to correct excessive joint size or scribing errors.

G. Integral Sinks:
1. Provide with overflows in locations shown on the Drawings.
2. Secure sinks to tops using manufacturer’s recommended sealant, adhesive and mounting hardware to maintain warranty.

3.3 ADJUSTMENT, CLEANING, AND PROTECTION

A. Repair damaged and defective work to eliminate visual and functional defects. Where repair is not possible, replace work.

B. Clean exposed surfaces.

C. Protect installed work from damage.

END OF SECTION

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Gate valves.
5. Chainwheels.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer.

C. FKM: Fluoroelastomer.

D. NBR: Nitrile butadiene rubber (also known as Buna-N).

E. NRS: Nonrising stem.

F. OS&Y: Outside screw and yoke.

G. PTFE: Polytetrafluoroethylene.

H. RPTFE: Reinforced polytetrafluoroethylene.

I. RS: Rising stem.

1.3 ACTION SUBMITTALS

A. Product data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

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1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for cast-copper solder-joint connections.
6. ASME B16.22 for wrought-copper solder-joint connections.
7. ASME B16.34 for flanged- and threaded-end connections.
8. ASME B16.51 for press joint connections.
9. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

H. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.
2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Provide memory stops that are fully adjustable after insulation is applied.

2.2 BALL VALVES, LEAD FREE

A. Ball Valves, Lead Free, Threaded Ends - Brass, One Piece:

1. Standards: MSS SP-110 and MSS SP-145.
2. CWP Rating: 400 psig (2760 kPa).
3. Body Design: One piece.
4. Body Material: Forged brass or bronze.
5. Ends: Threaded.
6. Seats: PTFE.

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7. Stem: Brass or stainless steel.
8. Ball: Chrome-plated brass or stainless steel.
9. Port: Reduced.

B. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Brass Trim:
1. Standards: MSS SP-110 and MSS SP-145.
2. CWP Rating: 600 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass.
5. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
6. Seats: PTFE.
7. Stem: Brass.
8. Ball: Chrome-plated brass.
9. Port: Full.

C. Ball Valves, Lead Free, Press Ends - Brass, Two Piece with Full Port and Brass Trim:
1. Standards: MSS SP-110, MSS SP-145, IAPMO/ANSI Z1157.
2. CWP Rating: Minimum 200 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass.
5. Ends: Press.
6. Press-End Connections Rating: Minimum 200 psig.
7. Seats: PTFE or RPTFE.
8. Stem: Brass.
9. Ball: Chrome-plated brass.
10. Port: Full.
11. O-Ring Seal: NBR or EPDM.

D. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Two Piece with Regular Port and Brass Trim:
1. Standards: MSS SP-110 and MSS SP-145.
2. CWP Rating: 600 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass.
5. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
6. Seats: PTFE.
7. Stem: Brass.
8. Ball: Chrome-plated brass.
9. Port: Regular.

E. Ball Valves, Lead Free, Threaded Ends - Bronze, One Piece with Bronze Trim:
1. Standards: MSS SP-110 and MSS SP-145.
2. CWP Rating: 400 psig.
3. Body Design: One piece.
4. Body Material: Bronze.
5. Ends: Threaded.
6. Seats: PTFE.
7. Stem: Bronze.
8. Ball: Chrome-plated brass.
9. Port: Reduced.

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F. Ball Valves, Lead Free, Threaded or Soldered Ends - Bronze, Two Piece with Full Port and Bronze or Brass Trim:
1. Standards: MSS SP-110 and MSS SP-145.
2. CWP Rating: 600 psig.
3. Body Design: Two piece.
4. Body Material: Bronze.
5. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
6. Seats: PTFE.
7. Stem: Bronze or brass.
8. Ball: Chrome-plated brass.
9. Port: Full.

G. Ball Valves, Lead Free, Press Ends - Bronze, Two Piece with Full Port and Bronze or Brass Trim:
1. Standards: MSS SP-110, MSS SP-145, and IAPMO/ANSI Z1157.
2. CWP Rating: Minimum 200 psig.
3. Body Design: Two piece.
4. Body Material: Bronze.
5. Ends: Press.
6. Press-End Connections Rating: Minimum 200 psig.
7. Seats: PTFE or RTPFE.
8. Stem: Bronze or brass.
9. Ball: Chrome-plated brass.
10. Port: Full.
11. O-Ring Seal: EPDM or NBR.

H. Ball Valves, Lead Free, Threaded Ends - Bronze, Two Piece with Regular Port and Bronze or Brass Trim:
1. Standards: MSS SP-110 and MSS SP-145.
2. CWP Rating: 600 psig.
3. Body Design: Two piece.
4. Body Material: Bronze.
5. Ends: Threaded.
6. Seats: PTFE.
7. Stem: Bronze or brass.
8. Ball: Chrome-plated brass.
9. Port: Regular.

I. Ball Valves, Lead Free, Flanged or Threaded Ends - Steel, with Full Port, Class 150:
1. Standards: MSS SP-72 and MSS SP-110.
2. CWP Rating: 285 psig.
3. Body Design: Split body.
4. Body Material: Carbon steel, ASTM A216/A216M, Type WCB.
5. Ends: Flanged or threaded. See Part 3 ball valve schedule articles.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.
9. Port: Full.

J. Ball Valves, Lead Free, Flanged or Threaded Ends - Steel, with Regular Port, Class 150:
1. Standards: MSS SP-72 and MSS SP-110.

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2. CWP Rating: 285 psig.
3. Body Design: Uni-body.
4. Body Material: Carbon steel, ASTM A216/A216M, Type WCB.
5. Ends: Flanged or threaded. See Part 3 ball valve schedule articles.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.
9. Port: Regular.

K. Ball Valves, Lead Free, Flanged or Threaded Ends - Iron, Class 125:
1. Standards: MSS SP-72, MSS SP-110, and MSS SP-145.
2. CWP Rating: 200 psig.
3. Body Design: Split body.
4. Body Material: ASTM A126, gray iron.
5. Ends: Flanged or threaded. See Part 3 ball valve schedule articles.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel.
9. Port: Full.

2.3 BALL VALVES, GENERAL PURPOSE

A. Ball Valves, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Brass Trim:
1. Standard: MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Forged brass.
6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
7. Seats: PTFE.
8. Stem: Brass.
9. Ball: Chrome-plated brass.
10. Port: Full.

B. Ball Valves, Threaded or Soldered Ends - Brass, Three Piece with Full Port and Brass Trim:
1. SWP Rating: 150 psig
2. CWP Rating: 600 psig.
3. Body Design: Three piece.
4. Body Material: Forged brass.
5. Ends: Threaded or soldered ends. See Part 3 ball valve schedule articles.
6. Seats: PTFE.
7. Stem: Brass.
8. Ball: Chrome-plated brass.
9. Port: Full.

C. Ball Valves, Threaded Ends - Bronze, Two Piece, Safety Exhaust:
1. Standards: MSS SP-110 and MSS SP-145.
2. CWP Rating: 200 psig or other pressure. See Part 3 ball valve schedule articles.
3. Body Design: Two piece.
4. Body Material: Bronze, ASTM B584, Alloy C844.

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5. Ends: Threaded.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
9. Port: Full.

D. Ball Valves, Flanged Ends - Iron, Class 125:
1. Standard: MSS SP-72.
2. CWP Rating: 200 psig.
3. Body Design: Split body.
4. Body Material: ASTM A126, gray iron.
5. Ends: Flanged.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel.
9. Port: Full.

2.4 CHECK VALVES, LEAD FREE

A. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:
1. Standard: MSS SP-80, Type 3.
2. CWP Rating: 200 psig.
3. Body Design: Horizontal flow.
4. Body Material: ASTM B62, bronze.
5. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
6. Disc: Bronze.

B. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 125:
1. Standard: MSS SP-80, Type 4.
2. CWP Rating: 200 psig.
3. Body Design: Horizontal flow.
4. Body Material: ASTM B62, bronze.
5. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
6. Disc: PTFE.

C. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:
1. Standard: MSS SP-80, Type 3.
2. CWP Rating: 300 psig
3. Body Design: Horizontal flow.
4. Body Material: ASTM B62, bronze.
5. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
6. Disc: Bronze.

D. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 150:
1. Standard: MSS SP-80, Type 4.
2. CWP Rating: 300 psig.

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3. Body Design: Horizontal flow.
4. Body Material: ASTM B62, bronze.
5. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
6. Disc: PTFE.

E. Check Valves, Lead Free, Swing Type, Press Ends - Bronze:
1. Standards: MSS SP-80 and MSS SP-139.
2. CWP Rating: Minimum 200 psig.
3. Body Design: Horizontal flow.
4. Body Material: ASTM B584, bronze.
5. Ends: Press.
6. Press-End Connections Rating: Minimum 200 psig.
7. Disc: Brass or bronze.

F. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Metal Seats, Class 125:
1. Standard: MSS SP-71, Type I.
2. CWP Rating: 200 psig.
3. Body Design: Clear or full waterway.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
6. Trim: Bronze.
7. Gasket: Asbestos free.

G. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Nonmetallic-to-Metal Seats, Class 125:
1. Standard: MSS SP-71, Type I.
2. CWP Rating: 200 psig.
3. Body Design: Clear or full waterway.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
6. Trim: Composition.
7. Seat Ring: Bronze.
8. Disc Holder: Bronze.
9. Disc: PTFE.
10. Gasket: Asbestos free.

H. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Metal Seats, Class 250:
1. Standard: MSS SP-71, Type I.
2. CWP Rating: 500 psig.
3. Body Design: Clear or full waterway.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
6. Trim: Bronze.
7. Gasket: Asbestos free.

I. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Lever- and Spring-Closure Control, Class 125:
1. Standard: MSS SP-71, Type I.
2. CWP Rating: 200 psig.

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3. Body Design: Clear or full waterway.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
6. Trim: Bronze.
7. Gasket: Asbestos free.
8. Closure Control: Factory-installed exterior lever and weight.

J. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Lever- and Weight-Closure Control, Class 125:
1. Standard: MSS SP-71, Type I.
2. CWP Rating: 200 psig.
3. Body Design: Clear or full waterway.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
6. Trim: Bronze.
7. Gasket: Asbestos free.
8. Closure Control: Factory-installed exterior lever and weight.

K. Check Valves, Lead Free, Swing Type, Grooved Ends - Iron, 300 CWP:
1. CWP Rating: 300 psig.
2. Body Material: ASTM A536, ductile iron.
3. Seat: EPDM.
4. Disc: Spring operated, ductile iron or stainless steel.

2.5 CHECK VALVES, GENERAL PURPOSE

A. Check Valves, Lift Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:
1. Standard: MSS SP-80, Type 1.
2. CWP Rating: 200 psig.
3. Body Design: Vertical flow.
4. Body Material: ASTM B61 or ASTM B62, bronze.
5. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
6. Disc: Bronze.

B. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:
1. Standard: MSS SP-80, Type 3.
2. CWP Rating: 200 psig.
3. Body Design: Horizontal flow.
4. Body Material: ASTM B62, bronze.
5. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
6. Disc: Bronze.

C. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 125:
1. Standard: MSS SP-80, Type 4.
2. CWP Rating: 200 psig.
3. Body Design: Horizontal flow.
4. Body Material: ASTM B62, bronze.
5. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
6. Disc: PTFE.

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D. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:
   1. Standard: MSS SP-80, Type 3.
   2. CWP Rating: 300 psig.
   3. Body Design: Horizontal flow.
   4. Body Material: ASTM B62, bronze.
   5. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
   6. Disc: Bronze.

E. Check Valves, Swing Type, Threaded or Soldered Ends - Bronze, with Nonmetallic Disc, Class 150:
   1. Standard: MSS SP-80, Type 4.
   2. CWP Rating: 300 psig.
   3. Body Design: Horizontal flow.
   4. Body Material: ASTM B62, bronze.
   5. Ends: Threaded or soldered ends. See Part 3 check valve schedule articles.
   6. Disc: PTFE.

F. Check Valves, Swing Type, Flanged Ends - Iron, with Metal Seats, Class 125:
   1. Standard: MSS SP-71, Type I.
   2. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig.
   3. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
   4. Body Design: Clear or full waterway.
   5. Body Material: ASTM A126, gray iron with bolted bonnet.
   6. Ends: Flanged.
   7. Trim: Bronze.
   8. Gasket: Asbestos free.

G. Check Valves, Swing Type, Flanged Ends - Iron, with Nonmetallic-to-Metal Seats, Class 125:
   1. Standard: MSS SP-71, Type I.
   2. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig.
   3. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
   4. Body Design: Clear or full waterway.
   5. Body Material: ASTM A126, gray iron with bolted bonnet.
   6. Ends: Flanged.
   7. Trim: Composition.
   8. Seat Ring: Bronze.
   9. Disc Holder: Bronze.
   10. Disc: PTFE.
   11. Gasket: Asbestos free.

H. Check Valves, Swing Type, Flanged Ends - Iron, with Metal Seats, Class 250:
   1. Standard: MSS SP-71, Type I.
   2. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 500 psig.
   3. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 300 psig.
   4. Body Design: Clear or full waterway.
   5. Body Material: ASTM A126, gray iron with bolted bonnet.
   6. Ends: Flanged.
   7. Trim: Bronze.
   8. Gasket: Asbestos free.

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I. Check Valves, Swing Type, Flanged Ends - Iron, with Lever- and Spring-Closure Control, Class 125:
   1. Standard: MSS SP-71, Type I.
   2. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig .
   3. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
   4. Body Design: Clear or full waterway.
   5. Body Material: ASTM A126, gray iron with bolted bonnet.
   6. Ends: Flanged.
   7. Trim: Bronze.
   8. Gasket: Asbestos free.
   9. Closure Control: Factory-installed, exterior lever and spring.

J. Check Valves, Swing Type, Flanged Ends - Iron, with Lever- and Weight-Closure Control, Class 125:
   1. Standard: MSS SP-71, Type I.
   2. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig.
   3. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
   4. Body Design: Clear or full waterway.
   5. Body Material: ASTM A126, gray iron with bolted bonnet.
   6. Ends: Flanged.
   7. Trim: Bronze.
   8. Gasket: Asbestos free.
   9. Closure Control: Factory-installed, exterior lever and weight.

K. Check Valves, Swing Type, Grooved Ends - Iron, 300 CWP:
   1. CWP Rating: 300 psig.
   2. Body Material: ASTM A536, ductile iron.
   3. Seat: NBR.
   4. Disc: Spring operated, ductile iron or stainless steel.

2.6 GATE VALVES, LEAD FREE

A. Gate Valves, Lead Free, Threaded or Soldered Ends - Bronze, NRS, Class 125:
   1. Standard: MSS SP-80, Type 1.
   2. CWP Rating: 200 psig.
   3. Body Material: Bronze with integral seat and screw-in bonnet.
   4. Ends: Threaded or solder joint. See Part 3 gate valve schedule articles.
   5. Stem: Bronze.
   6. Disc: Solid wedge, bronze.
   7. Packing: Asbestos free.
   8. Handwheel: Malleable iron.

B. Gate Valves, Lead Free, Threaded or Soldered Ends - Bronze, RS, Class 125:
   1. Standard: MSS SP-80, Type 2.
   2. CWP Rating: 200 psig.
   3. Body Material: Bronze with integral seat and screw-in bonnet.
   4. Ends: Threaded or solder joint. See Part 3 gate valve schedule articles.
   5. Stem: Bronze.
   6. Disc: Solid wedge, bronze.
   7. Packing: Asbestos free.

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8. Handwheel: Malleable iron, bronze, or aluminum.

C. Gate Valves, Lead Free, Threaded Ends - Bronze, NRS, Class 150:
1. Standard: MSS SP-80, Type 1.
2. CWP Rating: 300 psig.
3. Body Material: Bronze with integral seat and union-ring bonnet.
4. Ends: Threaded.
5. Stem: Bronze.
6. Disc: Solid wedge, bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron.

D. Gate Valves, Lead Free, Threaded Ends - Bronze, RS, Class 150:
1. Standard: MSS SP-80, Type 2.
2. CWP Rating: 300 psig.
3. Body Material: Bronze with integral seat and union-ring bonnet.
4. Ends: Threaded.
5. Stem: Bronze.
6. Disc: Solid wedge, bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron[, bronze, or aluminum].

E. Gate Valves, Lead Free, Press Ends - Bronze:
1. Standards: MSS SP-80 and MSS SP-139.
2. CWP Rating: Minimum 200 psig.
3. Body Material: Bronze with integral seat and union-ring bonnet.
4. Ends: Press.
5. Press Ends Connection Rating: Minimum 200 psig.
6. Stem: Brass or bronze, RS or NRS. See Part 3 gate valve schedule articles.
7. Disc: Solid wedge, bronze.
8. Packing: Graphite.
9. Port: Full.
10. Handwheel: Malleable iron, bronze, or aluminum.

F. Gate Valves, Lead Free, Flanged Ends - Iron, NRS, Class 125:
1. Standard: MSS SP-70, Type I.
2. CWP Rating: 200 psig.
3. Body Material: Gray iron with bolted bonnet.
4. Ends: Flanged.
5. Trim: Bronze.
6. Disc: Solid wedge.
7. Packing and Gasket: Asbestos free.

G. Gate Valves, Lead Free, Flanged Ends - Iron, OS&Y, Class 125:
1. Standard: MSS SP-70, Type I.
2. CWP Rating: 200 psig.
3. Body Material: Gray iron with bolted bonnet.
4. Ends: Flange.
5. Trim: Bronze.
6. Disc: Solid wedge.
7. Packing and Gasket: Asbestos free.

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H. Gate Valves, Lead Free, Flanged Ends - Iron, NRS, Class 250:
1. Standard: MSS SP-70, Type I.
2. CWP Rating: 500 psig.
3. Body Material: Gray iron with bolted bonnet.
4. Ends: Flange.
5. Trim: Bronze.
6. Disc: Solid wedge.
7. Packing and Gasket: Asbestos free.

I. Gate Valves, Lead Free, Flanged Ends - Iron, OS&Y, Class 250:
1. Standard: MSS SP-70, Type I.
2. CWP Rating: 500 psig.
3. Body Material: Gray iron with bolted bonnet.
4. Ends: Flanged.
5. Trim: Bronze.
6. Disc: Solid wedge.
7. Packing and Gasket: Asbestos free.

2.7 GATE VALVES, GENERAL PURPOSE

A. Gate Valves, Threaded or Soldered Ends - Bronze, NRS, Class 125:
1. Standard: MSS SP-80, Type 1.
2. CWP Rating: 200 psig.
3. Body Material: ASTM B62, bronze with integral seat and screw-in bonnet.
4. Ends: Threaded or soldered joint. See Part 3 gate valve schedule articles.
5. Stem: Bronze.
6. Disc: Solid wedge, bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron.

B. Gate Valves, Threaded or Soldered Ends - Bronze, RS, Class 125:
1. Standard: MSS SP-80, Type 2.
2. CWP Rating: 200 psig.
3. Body Material: ASTM B62, bronze with integral seat and screw-in bonnet.
4. Ends: Threaded or soldered joint. See Part 3 gate valve schedule articles.
5. Stem: Bronze.
6. Disc: Solid wedge, bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron, bronze, or aluminum.

C. Gate Valves, Threaded Ends - Bronze, NRS, Class 150:
1. Standard: MSS SP-80, Type 1.
2. CWP Rating: 300 psig.
3. Body Material: ASTM B62, bronze with integral seat and union-ring bonnet.
4. Ends: Threaded.
5. Stem: Bronze.
6. Disc: Solid wedge, bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron.

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D. Gate Valves, Threaded Ends - Bronze, RS, Class 150:
1. Standard: MSS SP-80, Type 2.
2. CWP Rating: 300 psig.
3. Body Material: ASTM B62, bronze with integral seat and union-ring bonnet.
4. Ends: Threaded.
5. Stem: Bronze.
6. Disc: Solid wedge, bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron.

E. Gate Valves, Flanged Ends - Iron, NRS, Class 125:
1. Standard: MSS SP-70, Type I.
2. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig.
3. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze.
7. Disc: Solid wedge.
8. Packing and Gasket: Asbestos free.

F. Gate Valves, Flanged Ends - Iron, OS&Y, Class 125:
1. Standard: MSS SP-70, Type I.
2. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig.
3. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze.
7. Disc: Solid wedge.
8. Packing and Gasket: Asbestos free.

G. Gate Valves, Flanged Ends - Iron, NRS, Class 250:
1. Standard: MSS SP-70, Type I.
2. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 500 psig.
3. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 300 psig.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze.
7. Disc: Solid wedge.
8. Packing and Gasket: Asbestos free.

H. Gate Valves, Flanged Ends - Iron, OS&Y, Class 250:
1. Standard: MSS SP-70, Type I.
2. CWP Rating, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 500 psig.
3. CWP Rating, NPS 14 to NPS 24 (DN 350 to DN 600): 300 psig.
4. Body Material: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze.
7. Disc: Solid wedge.
8. Packing and Gasket: Asbestos free.

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PART 3 - EXECUTION

3.1 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.

D. For valves in horizontal piping, install valves with stem at or above center of pipe.

E. Install valves in position that does not project into aisles or block access to other equipment.

F. Install valves in position to allow full stem and actuator or manual operator movement.

G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.

H. Install check valves for proper direction of flow and as follows:

1. Check Valves, Swing Type: In horizontal position with hinge pin level.

I. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

J. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
7. For Grooved-End Copper Tubing: Valve ends may be grooved.
8. For Grooved-End Steel Piping: Valve ends may be grooved.

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9. Wafer-Type Valves: Flanged connections.

3.3 LOW-PRESSURE, COMPRESSED-AIR BALL VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball valves, threaded or soldered ends - brass, two piece with full port and brass trim; threaded or soldered ends.
2. Ball valves, threaded ends - bronze, two piece, safety exhaust; 200 psig

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Ball valves, flanged ends - iron, Class 125.

3.4 HIGH-PRESSURE, COMPRESSED-AIR BALL VALVE SCHEDULE - 150 TO 200 PSIG (1035 TO 1380 kPa)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball valves, threaded or soldered ends - brass, three piece with full port and brass trim; threaded or soldered ends.
2. Ball valves, threaded or soldered ends - brass, two piece with full port and brass trim; threaded or soldered ends.
3. Ball valves, threaded ends - bronze, two piece, safety exhaust; 200 psig

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Ball valves, flanged ends - iron, Class 125.

3.5 DOMESTIC HOT- AND COLD-WATER BALL VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Ball valves, lead free, threaded ends - brass, one piece.
2. Ball valves, lead free, threaded or soldered ends - brass, two piece with full port and brass trim; threaded or soldered ends.
3. Ball valves, lead free, press ends - brass, two piece with full port and brass trim.
4. Ball valves, lead free, threaded or soldered ends - brass, two piece with regular port and brass trim; threaded or soldered ends.
5. Ball valves, lead free, threaded ends - bronze, one piece with bronze trim.
6. Ball valves, lead free, threaded or soldered ends - bronze, two piece with full port and bronze or brass trim; threaded or soldered ends.
7. Ball valves, lead free, press ends - bronze, two piece with full port and bronze or brass trim.
8. Ball valves, lead free, threaded ends - bronze, two piece with regular port and bronze or brass trim.
9. Ball valves, lead free, flanged or threaded ends - steel, with full port, Class 150; threaded or soldered ends.

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B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Ball valves, lead free, flanged or threaded ends - iron, Class 125; flanged or threaded ends.
2. Ball valves, lead free, flanged or threaded ends - steel, with full port, Class 150; flanged or threaded ends.
3. Ball valves, lead free, flanged or threaded ends - steel, with regular port, Class 150; flanged or threaded ends.

3.6 DOMESTIC HOT- AND COLD-WATER CHECK VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 125; threaded or soldered ends.
2. Check valves, lead free, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 125; threaded or soldered ends.
3. Check valves, lead free, swing type, threaded or soldered ends - bronze, with bronze disc, Class 150; threaded or soldered ends.
4. Check valves, lead free, swing type, threaded or soldered ends - bronze, with nonmetallic disc, Class 150; threaded or soldered ends.
5. Check valves, lead free, swing type, press ends - bronze.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Check valves, lead free, swing type, flanged or threaded ends - iron, with metal seats, Class 125; threaded or soldered ends.
2. Check valves, lead free, swing type, flanged or threaded ends - iron, with nonmetallic-to-metal Seats, Class 125; threaded or soldered ends.
3. Check valves, lead free, swing type, flanged or threaded ends - iron, with metal seats, Class 250; flanged or threaded ends.
4. Check valves, lead free, swing type, flanged or threaded ends - iron, with lever- and spring-closure control, Class 125; flanged or threaded ends.
5. Check valves, lead free, swing type, flanged or threaded ends - iron, with lever- and weight-closure control, Class 125; flanged or threaded ends.
6. Check valves, lead free, swing type, grooved ends - iron, 300 CWP.

3.7 DOMESTIC HOT- AND COLD-WATER GATE VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Gate valves, lead free, threaded or soldered ends - bronze, NRS, Class 125; threaded or soldered ends.
2. Gate valves, lead free, threaded or soldered ends - bronze, RS, Class 125; t threaded or soldered ends.
3. Gate valves, lead free, threaded ends - bronze, NRS, Class 150.
4. Gate valves, lead free, threaded ends - bronze, RS, Class 150.
5. Gate valves, lead free, press ends - bronze.

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B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Gate valves, lead free, flanged ends - iron, NRS, Class 125.
2. Gate valves, lead free, flanged ends - iron, OS&Y, Class 125.
3. Gate valves, lead free, flanged ends - iron, NRS, Class 250.
4. Gate valves, lead free, flanged ends - iron, OS&Y, Class 250.

END OF SECTION 220523

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal hanger-shield inserts.
4. Fastener systems.
5. Pipe-positioning systems.
6. Equipment supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations.

D. Delegated Design Submittals: 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.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon or stainless steel.

B. Stainless Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated or stainless steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

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2.4 THERMAL HANGER-SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Indoor Applications: Zinc-coated or stainless steel.
   2. Outdoor Applications: Stainless steel.

2.6 PIPE-POSITIONING SYSTEMS

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

2.7 EQUIPMENT SUPPORTS

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

2.8 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

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E. Grout: ASTM C1107/C1107M, 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

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure..

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

D. 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.

E. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

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G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. 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 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
    b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.

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5. Pipes NPS 8 (DN 200) 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 of same thickness as piping insulation.

3.3 INSTALLATION OF EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications 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.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting.", Section 099600 "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

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3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless steel pipe hangers 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.

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11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

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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.

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6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

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SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient support.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraints - rigid type.
14. Restraints - cable type.
15. Restraint accessories.
16. Post-installed concrete anchors.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:

1. For each seismic-restraint device, including seismic-restrained mounting, pipe-riser resilient support, snubber, seismic restraint, seismic-restraint accessory, and concrete

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anchor and insert, that is required by this Section or is indicated on Drawings, submit the following:

a. Seismic and wind-load restraint, and vibration isolator, and isolation base selection: Select vibration isolators, seismic and wind-load restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
c. Concrete Anchors and Inserts: Include calculations showing anticipated seismic and wind loads. Include certification that device is approved by an NRTL for seismic reinforcement use.
d. Seismic Design Calculations: Submit all input data and loading calculations prepared in "Performance Requirements" Article in "Seismic Design Calculations" Paragraph.
e. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared in "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.
f. Qualified Professional Engineer: All designated-design submittals for seismic and wind-load-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.

2. Seismic- and Wind-Load- Restraint Detail Drawing:

a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Coordinate seismic restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.

3. Product Listing, Preapproval, and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
4. All delegated-design submittals for seismic- and wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
5. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

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1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Welding certificates.

C. Field quality-control reports:

D. Seismic Qualification Data: Provide special certification for designated seismic systems as indicated in ASCE/SEI 7-05, ASCE/SEI 7-10, ASCE/SEI 7-16, Paragraph 13.2.2, "Special Certification Requirements for Designated Seismic Systems" for all Designated Seismic Systems identified as such on Drawings or in the Specifications.

1. Provide equipment manufacturer's written certification for each designated active plumbing seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7 and AHRI 1270, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction, or experience data as permitted by ASCE/SEI 7-05, ASCE/SEI 7-10, ASCE/SEI 7-16.
2. Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7-05, ASCE/SEI 7-10, ASCE/SEI 7-16.
3. Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by a licensed professional engineer.
4. The following plumbing systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:

E. Wind-Force Performance Certification: Provide special certification for plumbing components subject to high wind exposure and impact damage and designated on Drawings or in the Specifications to require wind-force performance certification.

1. Provide equipment manufacturer's written certification for each designated plumbing device, stating that it will remain in place and operable following the design wind event and comply with all requirements of authorities having jurisdiction.
2. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7, and be acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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C. Seismic-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: an an agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic [and wind-load]control system.

1. Seismic Performance: Equipment shall withstand the effects of earthquake motions and high wind events] determined in accordance with ASCE/SEI 7-05, ASCE/SEI 7-10 ASCE/SEI 7-16.

B. Seismic Design Calculations:

1. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-05, ASCE/SEI 7-10 including supplement No. 1, ASCE/SEI 7-16 or other seismic calculation method required by authorities having jurisdiction. Where "ASCE/SEI 7" is used throughout this Section, it is to be understood that the edition referred to in this subparagraph is the edition intended as reference throughout the section text.

a. Data indicated below to be determined by Delegated-Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
b. Coordinate seismic design calculations with wind-load calculations for equipment mounted outdoors. Comply with requirements in other Sections in conjunction with structural calculations and drawings.

C. Component Supports:

1. Load Ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.
2. All component support attachments must comply with force and displacement resistance requirements of ASCE/SEI 7-05 Section 13.6, ASCE/SEI 7-10 Section 13.6, ASCE/SEI 7-16 Section 13.6.

2.2 PIPE-RISER RESILIENT SUPPORT

A. All-Directional, Acoustical Pipe Anchor Consisting of Two Steel Tubes Separated by a Minimum 1/2-inch Thick Neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.

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2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.3 RESILIENT PIPE GUIDES

A. Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-inch Thick Neoprene.
   1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.4 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods

   1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.

2.5 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.

   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.6 RESTRAINTS - RIGID TYPE

A. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building

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structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.7 RESTRAINTS - CABLE TYPE

A. Seismic Restraint Cables: ASTM A1023/A1023M galvanized or ASTM A603 galvanized-steel, ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.

B. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge type end fittings do not comply and are unacceptable.

2.8 RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod. Non-metallic stiffeners are unacceptable.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

C. 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.

D. 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.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.9 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

B. Provide post-installed concrete anchors that have been prequalified for use in seismic applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-05, Ch. 13, ASCE/SEI 7-10, Ch. 13, ASCE/SEI 7-16, Ch. 13.

1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

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C. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp, which is not vibration isolated.

1. Undercut expansion anchors are permitted.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static[, wind load,] and seismic load within specified loading limits.

3.2 INSTALLATION OF VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICES

A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules, where indicated on Drawings, or where the Specifications indicate they are to be installed on specific equipment and systems.

B. Provide seismic-restraint devices for systems and equipment where indicated in Equipment Schedules or Seismic-Restraint Devices Schedules, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.

C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

D. Installation of vibration isolators and seismic restraints must not cause any stresses, misalignment, or change of position of equipment or piping.

E. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

F. Equipment Restraints:
1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

G. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c.

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3. Brace a change of direction longer than 12 feet.

H. Install seismic restraint cables so they do not bend across edges of adjacent equipment or building structure.

I. Install seismic restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

J. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

K. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

L. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

M. Post-Installed Concrete 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 Project 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. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Provide flexible connections in piping systems where they cross structural seismic joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Section 221116 "Domestic Water Piping" and Section 221119 "Domestic Water Piping Specialties" for piping flexible connections.

3.4 ADJUSTING

A. Adjust isolators after system is at operating weight.

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B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Perform tests and inspections with the assistance of a factory-authorized service representative.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
5. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
6. Test to 90 percent of rated proof load of device.
7. Measure isolator restraint clearance.
8. Measure isolator deflection.
9. Verify snubber minimum clearances.
10. Test and adjust restrained-air-spring isolator controls and safeties.

C. Remove and replace malfunctioning units and retest as specified above.

D. Units will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 220548

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

B. Related Requirements:

1. Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical, compressed-air system piping and associated components in healthcare facilities.
2. Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical surgical, healthcare laboratory, and dental vacuum system piping, waste anesthetic gas and oral evacuation system piping, and associated components in healthcare facilities.
3. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities" for labeling requirements, complying with NFPA 99, for medical carbon dioxide, laboratory carbon dioxide, medical helium, laboratory helium, medical nitrogen, laboratory nitrogen, medical nitrous oxide, laboratory nitrous oxide, medical oxygen, and laboratory oxygen.

1.2 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

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4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of 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.
5. Fasteners: Stainless steel rivets or self-tapping screws.
6. 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, minimum 1/16 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of 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.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. 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), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, minimum 1/16 inch thick, with predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of 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.

F. Fasteners: Stainless steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E[, and other applicable codes and standards].

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I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to [partially cover] [cover full] circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on[main] distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of plumbing equipment.

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B. Sign and Label Colors.

1. White letters on an ANSI Z535.1 safety-green background.

C. Locate equipment labels where accessible and visible.

D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where are-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E[, and other applicable codes and standards].

3.4 INSTALLATION OF PIPE LABELS

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.

D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

F. Pipe-Label Color Schedule:
1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
3. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background.
4. Sanitary Waste and Storm Drainage Piping: White letters on a black background

END OF SECTION 220553

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SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Domestic chilled-water piping for drinking fountains.
5. Sanitary waste piping exposed to freezing conditions.
6. Storm-water piping exposed to freezing conditions.
7. Roof drains and rainwater leaders.
8. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material test reports.

C. Field quality-control reports.

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1.4 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. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

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2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
   1. Preformed Pipe Insulation: Type II, Class 1, unfaced.
   2. Preformed Pipe Insulation: Type II, Class 2, with factory-applied jacket.
   3. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.
   4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.

H. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F (454 deg C) in accordance with ASTM C411. Comply with ASTM C547.
   1. Preformed Pipe Insulation: Type I, Grade A, unfaced with factory-applied ASJ
   2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
   3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C547.
   1. Preformed Pipe Insulation: Type II, Grade A[, unfaced] [with factory-applied ASJ] [with factory-applied ASJ-SSL] [with factory-applied ASJ+ jacket] [with factory-applied PSK jacket].
   2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

J. Polyolefin: Polyethylene thermal plastic insulation. Comply with ASTM C534/C534M or ASTM C1427, Type I, Grade 1, for tubular materials[, self-seal].

2.3 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.

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B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
2. Wet Flash Point: Below 0 deg F
3. Service Temperature Range: 40 to 200 deg
4. Color: Black.

D. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

E. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: 0 to plus 180 deg F
3. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

2.5 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
1. Permanently flexible, elastomeric sealant.
2. Service Temperature Range: Minus 58 to plus 176 deg F .
3. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: Aluminum.

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D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.
   3. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
   4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
   5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Adhesive: As recommended by jacket material manufacturer.
   2. Color: White.
   3. 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. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Finish and thickness are indicated in field-applied jacket schedules.
      b. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper, 3-mil thick, heat-bonded polyethylene and kraft paper, or 3-mil thick polysurlyn.
      c. Moisture Barrier for Outdoor Applications:3-mil thick, heat-bonded polyethylene and kraft paper or 3-mil thick polysurlyn.
      d. Factory-Fabricated Fitting Covers:

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1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. 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.

F. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.

G. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in.for covering pipe and pipe fittings.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches .
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

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1. Width: 3 inches
2. Thickness: 6.5 mils
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches
2. Thickness: 6 mils
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5percent.
5. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:
1. Stainless Steel: ASTM A240/A240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy soft-annealed, stainless steel.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

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

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the contract documents, unless otherwise approved by the engineer-of-record.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

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I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

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3.3 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 078413 "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 078413 "Penetration Firestopping."

3.4 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 below.

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B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

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1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 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 jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with 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 prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
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 prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

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2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
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 prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

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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 jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with 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 prefabricated 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 glass-fiber or mineral-wool 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive, or via self-seal mechanism 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.

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2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 INSTALLATION OF FIELD-APPLIED JACKETS

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. 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.

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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.

3.10 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "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.

3.11 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

E. All insulation applications will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.12 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.

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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.

3.13 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.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 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. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
d. Polyolefin: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inch thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
d. Polyolefin: 3/4 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be[one of] the following:

a. Flexible Elastomeric: 1 inch thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
d. Polyolefin: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1/2 inch thick.
b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
c. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
d. Polyolefin: 1/2 inch thick.

D. Sanitary Waste Piping Where Heat Tracing Is Installed:

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1. All Pipe Sizes: Insulation shall be one of the following:

    a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
    b. Mineral Wool, Preformed Pipe Insulation, Type II: 1-1/2 inches thick.

E. 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. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
    c. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch thick.
    d. Polyolefin: 3/4 inch thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. Cellular Glass: 2 inches thick.
    b. Flexible Elastomeric: 2 inches thick.
    c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
    d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.
    e. Polyolefin: 2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be[one of] the following:

    a. Cellular Glass: 2 inches thick.
    b. Flexible Elastomeric: 2 inches thick.
    c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
    d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.
    e. Polyolefin: 2 inches thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be[one of] the following:

    a. Cellular Glass: [2 inches (50 mm)] <Insert dimension> thick.
    b. Glass-Fiber, Preformed Pipe Insulation, Type I: [2 inches (50 mm)] <Insert dimension> thick.
    c. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.

3.15 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.

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B. If more than one material is listed, selection from materials listed is Contractor's option.

3.16 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.

3.17 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

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

END OF SECTION 220719

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SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. Ductile-iron pipe and fittings - domestic water.
3. Galvanized-steel pipe and fittings - domestic water.
4. CPVC piping - domestic water.
5. PEX tube and fittings - domestic water.
6. PVC pipe and fittings - domestic water.
7. Piping joining materials - domestic water.
8. Transition fittings - domestic water.
9. Dielectric fittings - domestic water.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product data.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. System purging and disinfecting activities report.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

A. Drawn-Temper Copper Tube: ASTM B88, Type K, ASTM B88, Type L and ASTM B88 Type M.

B. Annealed-Temper Copper Tube: ASTM B88, Type K, ASTM B88, Type L and ASTM B88, Type M.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.

F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.

G. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.

H. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:
   1. Housing: Copper.
   2. O-Rings and Pipe Stops: EPDM.
   3. Tools: Manufacturer's special tools.
   4. Minimum 200 psig working-pressure rating at 250 deg F.

I. Copper-Tube, Push-on-Joint Fittings - Domestic Water:
   1. Description:

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a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
b. Stainless steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.4 DUCTILE-IRON PIPE AND FITTINGS - DOMESTIC WATER

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Standard-Pattern, Push-on Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Gaskets: AWWA C111/A21.11, rubber.

E. Compact-Pattern, Push-on Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Gaskets: AWWA C111/A21.11, rubber.

F. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

G. Appurtenances for Grooved-End, Ductile-Iron Pipe - Domestic Water:
1. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions that match pipe.
2. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:

a. AWWA C606 for ductile-iron-pipe dimensions.
b. Ferrous housing sections.
c. EPDM-rubber gaskets suitable for hot and cold water.
d. Bolts and nuts.
e. Minimum Pressure Rating:

1) NPS 14 to NPS 18 (DN 350 to DN 450): 250 psig.
2) NPS 20 to NPS 46 (DN 500 to DN 900): 150 psig.

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2.5 GALVANIZED-STEEL PIPE AND FITTINGS - DOMESTIC WATER

A. Galvanized-Steel Pipe:

1. ASTM A53/A53M, Type E, Grade B, Standard Weight.
2. Include ends matching joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106/A106M, Standard Weight, seamless steel pipe with threaded ends.

C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

D. Malleable-Iron Unions:

1. ASME B16.39, Class 150.
2. Hexagonal-stock body.
3. Ball-and-socket, metal-to-metal, bronze seating surface.
4. Threaded ends.

E. Flanges: ASME B16.1, Class 125, cast iron.

2.6 CPVC PIPING - DOMESTIC WATER

A. CPVC Pipe: ASTM F441/F441M, with wall thickness as indicated in "Piping Applications" Article.

1. CPVC Socket Fittings: ASTM F438 for Schedule 40 and ASTM F439 for Schedule 80.
2. CPVC Threaded Fittings: ASTM F437, Schedule 80.

B. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings.

C. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings.

2.7 PEX TUBE AND FITTINGS - DOMESTIC WATER

A. PEX Tube - Domestic Water:
1. Tube Material: PEX plastic in accordance with ASTM F876[and ASTM F877].

B. PEX Tube Fittings - Domestic Water:
1. Fittings: ASTM F1807, metal insert and copper crimp rings ASTM F1960, cold expansion fittings and reinforcing rings.
2. Push-Fit Fittings: ASSE 1061, push-fit fittings.

C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F876; with plastic or corrosion-resistant-metal valve for each outlet.

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2.8 PVC PIPE AND FITTINGS - DOMESTIC WATER

A. PVC Pipe - Domestic Water: ASTM D1785, with wall thickness as indicated in "Piping Applications" Article.

B. PVC Socket Fittings: ASTM D2466 for Schedule 40 and ASTM D2467 for Schedule 80.

C. PVC Schedule 80 Threaded Fittings: ASTM D2464.

2.9 PIPING JOINING MATERIALS - DOMESTIC WATER

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.

G. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.

H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.10 TRANSITION FITTINGS - DOMESTIC WATER

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.

D. Plastic-to-Metal Transition Fittings - Domestic Water:
1. Description:

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a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket[or threaded] end.

E. Plastic-to-Metal Transition Unions - Domestic Water:
1. Description:

a. CPVC or PVC four-part union.
b. Brass or stainless steel threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

2.11 DIELECTRIC FITTINGS - DOMESTIC WATER

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 - Domestic Water:
1. Standard: ASSE 1079.
2. Pressure Rating: 125 psig minimum at 180 deg F .
3. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges - Domestic Water:
1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits - Domestic Water:
1. Nonconducting materials for field assembly of companion flanges.
2. Pressure Rating: 150 psig .
3. Gasket: Phenolic, Temperature Rating: 225 deg F.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples - Domestic Water:
1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F1545.
3. Pressure Rating and Temperature: 300 psig at 225 deg F.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

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PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. 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 (DN 80) and smaller is to be the following:

1. Annealed-temper copper tube, ASTM B88, Type K; joints.
2. PVC, Schedule 40 socket fittings; and solvent-cemented joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger is to be the following:

1. Annealed-temper copper tube, ASTM B88, 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. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
4. PVC, Schedule 40; socket fittings; and solvent-cemented joints.

F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300) is to be the following:

1. Mechanical-joint, ductile-iron pipe; standard or compact pattern, mechanical-joint fittings; and mechanical joints.
2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

G. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller is to be the following:

1. Drawn-temper or annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed or copper pressure-seal-joint fittings; and pressure-sealed joints.
2. PVC, Schedule 40; socket fittings; and solvent-cemented joints.

H. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:

1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
2. Drawn-temper copper tube, ASTM B88, Type L, ASTM B88, Type M; cast- or wrought-copper, solder-joint fittings; and brazed soldered joints.

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3. Drawn-temper copper tube, [ASTM B88, Type L (ASTM B88M, Type B)] [ASTM B88, Type M (ASTM B88M, Type C)]; copper pressure-seal-joint fittings; and pressure-sealed joints.
4. Drawn-temper copper tube, [ASTM B88, Type L (ASTM B88M, Type B)] [ASTM B88, Type M (ASTM B88M, Type C)]; copper push-on joint fittings; and push-on joints.
5. CPVC, [Schedule 40] [Schedule 80]; socket fittings; and solvent-cemented joints.
6. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
7. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints.[NPS 1-1/2 (DN 40) and NPS 2 (DN 50) CPVC pipe with CPVC socket fittings may be used instead of tubing.]

Tube in first two subparagraphs below is available only in NPS 1 (DN 25) and smaller.

8. PEX tube, NPS 1 (DN 25) and smaller.

    a. Fittings for PEX tube:

        1) ASTM F1807, metal insert and copper crimp rings.
        2) ASTM F1960, cold expansion fittings and reinforcing rings.
        3) ASSE 1061, push-fit fittings.

9. PEX-AL-PEX tube, NPS 1 (DN 25) and smaller; fittings for PEX-AL-PEX tube; and crimped joints.
10. PVC, [Schedule 40] [Schedule 80]; socket fittings; and solvent-cemented joints.

I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) is to be the following:

1. Drawn-temper copper tube, [ASTM B88, Type L (ASTM B88M, Type B)] [ASTM B88, Type M (ASTM B88M, Type C)]; [cast-] [or] [wrought-]copper, solder-joint fittings; and [brazed] [soldered] joints.
2. Drawn-temper copper tube, [ASTM B88, Type L (ASTM B88M, Type B)] [ASTM B88, Type M (ASTM B88M, Type C)]; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
4. CPVC, [Schedule 40] [Schedule 80]; socket fittings; and solvent-cemented joints.
5. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
6. PVC, [Schedule 40] [Schedule 80]; socket fittings; and solvent-cemented joints.

J. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200), is to be the following:

1. Drawn-temper copper tube, [ASTM B88, Type L (ASTM B88M, Type B)] [ASTM B88, Type M (ASTM B88M, Type C)]; [cast-] [or] [wrought-]copper, solder-joint fittings; and [brazed] [soldered] joints.
2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

Schedule 40 pipe fittings in first subparagraph below are available only in NPS 6 (DN 150) and smaller.

3. CPVC, [Schedule 40] [Schedule 80]; socket fittings; and solvent-cemented joints.
4. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.

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5. PVC, Schedule 40; socket fittings; and solvent-cemented joints.

K. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300) is to be the following:

1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints in accordance with AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement in accordance with ASTM A674 or AWWA C105/A21.5.

E. Install valves in accordance with Section 220523 "General-Duty Valves for Plumbing Piping."

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

G. Install domestic water piping level with 0.25 percent slope downward toward and plumb.

H. Rough-in domestic water piping for water-meter installation in accordance with utility company's requirements.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. 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.

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L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install PEX tube with loop at each change of direction of more than 90 degrees.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220500 "Common Work Results for Plumbing."

T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123.21 "Inline, Domestic Water Pumps."

U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220500 "Common Work Results for Plumbing."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.4 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 in accordance with 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.

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2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on joint fittings by inserting tube to measured depth.

H. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

I. Joint Construction for Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints in accordance with AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

K. Joint Construction for Grooved-End Steel Piping: Make joints in accordance with AWWA C606. Square cut groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

L. 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 in accordance with ASME B31.9.

M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join in accordance with ASTM D2846/D2846M.
3. PVC Piping: Join in accordance with ASTM D2855.

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N. Joints for PEX Tubing, ASTM: Join in accordance with ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.

O. Joints for PEX Tubing, ASSE: Join in accordance with ASSE 1061 for push-fit fittings.

P. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges

D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

C. Install hangers for copper, ductile iron, galvanized steel and stainless steel tube and pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install vinyl-coated hangers for CPVC pipe, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Install vinyl-coated hangers for PEX tube, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

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F. Support horizontal piping within 12 inches of each fitting.

G. Support vertical runs of copper, ductile iron, galvanized steel, and stainless steel tube and pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

H. Support vertical runs of CPVC pipe to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

I. Support vertical runs of PEX tube to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

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a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system in accordance with either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. 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.

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3.12 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.
f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
g. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 221116

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. ABS pipe and fittings.
4. PVC pipe and fittings.
5. Specialty pipe fittings.

B. Related Requirements:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
2. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.
3. Section 226600 "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.2 ACTION SUBMITTALS

A. Product data.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.

B. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

C. Field quality-control reports.

1.4 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10 ft. head of water

B. Seismic Performance: Soil, waste, and vent piping and support and installation to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7. See Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment":

1. 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."

2.2 PIPING MATERIALS

A. Piping materials to bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

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

A. Pipe and Fittings:

1. Marked with CISPI collective trademark.
2. ASTM A74, service and extra-heavy cast iron.

B. Gaskets: ASTM C564, rubber.

C. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings:

1. Marked with CISPI collective trademark.
2. ASTM A888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:
1. Standards: ASTM C1277 and CISPI 310.
2. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

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1. Standards: ASTM C1277 and ASTM C1540. <Insert standard>.
2. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.5 ABS PIPE AND FITTINGS

A. NSF Marking: Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall ABS Pipe: ASTM D2661, Schedule 40.

C. Cellular-Core ABS Pipe: ASTM F628, Schedule 40.

D. ABS Socket Fittings: ASTM D2661, made in accordance with ASTM D3311, drain, waste, and vent patterns.

E. Solvent Cement: ASTM D2235.

2.6 PVC PIPE AND FITTINGS

A. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.

C. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.

D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F656.

F. Solvent Cement: ASTM D2564.

2.7 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
    a. Standard: ASTM C1173.
    b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    c. End Connections: Same size as and compatible with pipes to be joined.

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d. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:
   a. Standard: ASTM C1460.
   b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   c. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

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J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment".

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

    a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of waste piping in direction of flow is prohibited.

L. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
3. Vent Piping: Two percent down toward vertical fixture vent or toward vent stack.

N. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

O. Install aboveground ABS piping in accordance with ASTM D2661.

P. Install aboveground PVC piping in accordance with ASTM D2665.

Q. Install underground ABS and PVC piping in accordance with ASTM D2321.

R. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping.

    a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."

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2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

    a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary waste gravity-flow piping.

    a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

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

T. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."

U. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.

C. Hubless, Cast-Iron Soil Piping Coupled Joints:

1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

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3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment".

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless steel or fiberglass pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42 clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52 spring hangers.

C. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install hangers for ABS and PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping and tubing within 12 inches of each fitting[, valve,] and coupling.

F. Support vertical runs of cast-iron soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs of ABS and PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

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1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with.
6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections in accordance with the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

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D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

    a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water
    b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

    a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg
    b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

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3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 are to 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 and hubless, single-stack aerator fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, soil and waste piping NPS 5 are to be the following:

1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; hubless-piping couplings; and coupled joints.
3. PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 (DN 100) and smaller is to be any of the following:

1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
3. ABS pipe, ABS socket fittings, and solvent-cemented joints.
4. PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: nonpressure transition couplings.

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SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial, atmospheric, gas-fired, storage, domestic-water heaters.
2. Commercial, power-burner, gas-fired, storage, domestic-water heaters.
3. Commercial, direct-vent, gas-fired, storage, domestic-water heater.
4. Commercial, grid-type, finned-tube, gas-fired, domestic-water heaters.
5. Residential, atmospheric, gas-fired, storage, domestic-water heaters.
6. Residential, power-vent, gas-fired, storage, domestic-water heaters.
7. Commercial, oil-fired, storage, domestic-water heaters.
8. Commercial, large-volume, oil-fired, domestic-water heaters.
9. Residential, oil-fired, storage, domestic-water heaters.
10. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.

C. Product Certificates: For each type of commercial, gas-fired domestic-water heater.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample warranty.

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1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 COORDINATION

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

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.

a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:

1) Storage Tank: Five years.
2) Controls and Other Components: Two year(s).

b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

1. 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."

C. ASHRAE/IES Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IES 90.1.

D. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

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E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Atmospheric, Gas-Fired, Storage, Domestic-Water Heaters:
1. Standard: ANSI Z21.10.3/CSA 4.3.
2. Storage-Tank Construction: ASME-code steel with 150-psig working-pressure rating.

a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

1) NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
2) NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.

b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Lining: Cement, Glass, Nickel plate, Phenolic coating, or Sheet copper complying with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

3. Factory-Installed, Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
c. Drain Valve: Corrosion-resistant metal with hose-end connection.
d. Insulation: Comply with ASHRAE/IES 90.1. Surround entire storage tank except connections and controls.
e. Jacket: Steel with enameled finish.
f. Burner: For use with atmospheric, gas-fired, domestic-water heaters and natural-gas.
g. Ignition: Standing pilot or ANSI Z21.20/CSA C22.2 No. 60730-2-5, electric, automatic, gas-ignition system.
h. Temperature Control: Adjustable thermostat.
i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction.
5. Draft Hood: Draft diverter, complying with ANSI Z21.12.
6. Automatic Damper: ANSI Z21.66/CSA 6.14, thermally activated, automatic-vent-damper device with size matching draft hood.

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2.3

2.4 COMMERCIAL, GAS- AND OIL-FIRED, DOMESTIC-WATER HEATERS

A. Description: Comply with ANSI Z21.10.3/CSA 4.3 or UL 732 requirements appropriate for dual-fuel, gas- and oil-fired, domestic-water heaters.

B. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

a. NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
b. NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.

2. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
3. Lining: Cement, Glass, Nickel plate, Phenolic coating, or Sheet copper complying with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

C. Factory-Installed, Storage-Tank Appurtenances:

1. Anode Rod: Replaceable magnesium.
2. Dip Tube: Required unless cold-water inlet is near bottom of tank.
3. Drain Valve: Corrosion-resistant metal with hose-end connection.
4. Insulation: Comply with ASHRAE/IES 90.1.
5. Jacket: Steel with enameled finish.
6. Temperature Control: Adjustable thermostat.
7. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

D. Fuel Burner:

1. Standards: Combination gas-and-oil burner assembly, complying with appropriate requirements of UL 795; or comply with UL 296 for oil burners for No. 2 fuel oil and UL 795 for natural-gas fuel.
2. Safety Control: Automatic, high-temperature-limit cutoff device or system.
3. Vent Connection: In accordance with standards of authorities having jurisdiction for dual-fuel, domestic-water heaters.

E. Capacity and Characteristics:
1. See plumbing schedule on sheet P1.1.

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2.5 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:
   1. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
   2. Construction:
      a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
      b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
      c. Air-Charging Valve: Factory installed.
   3. Capacity and Characteristics:
      a. Working-Pressure Rating: 100 psig.

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
   1. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1, manually operated. Furnish for installation in piping.

G. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig pressure rating as required to match gas supply.

H. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

I. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
   1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
   2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.

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J. Pressure Relief Valves: Include pressure setting less than working-pressure rating of domestic-water heater.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.

K. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

L. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater minimum of 18 inches above the floor.

M. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.6 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters[and storage tanks] specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF DOMESTIC-WATER HEATER

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. 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 concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

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B. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" and Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

G. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill domestic-water heaters with water.

J. Charge domestic-water expansion tanks with air to required system pressure.

K. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

L. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.2 PIPING CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

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B. Comply with requirements for fuel-oil piping specified in Section 231113 "Facility Fuel-Oil Piping."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

END OF SECTION 223400

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SECTION 224200 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial lavatories.
2. Commercial showers.
3. Commercial sinks.
4. Commercial urinals.
5. Commercial water closets.
6. Flushometer valves.
7. Toilet seats.
8. Fixture carriers.

B. Related Requirements:

1. Section 114000 "Foodservice Equipment" for NSF-compliant foodservice and handwash sinks.
2. Section 224100 "Residential Plumbing Fixtures" for residential plumbing fixtures.
3. Section 224300 "Healthcare Plumbing Fixtures" for healthcare plumbing fixtures.
4. Section 224500 "Emergency Plumbing Fixtures" for emergency plumbing fixtures.
5. Section 224600 "Security Plumbing Fixtures" for security plumbing fixtures.

1.2 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings:

1. Plans, elevations, sections, and mounting attachment details.
2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories and/or counter-mounted sinks.

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1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Lavatory faucets, sink faucets, shower valves, and wash fountain spray heads and faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 COMMERCIAL LAVATORIES

A. Lavatories:

1. Lavatory,– see plumbing fixtures schedule on sheet P1.1

2.3 COMMERCIAL SINKS

A. Service Sinks, Floor Mounted:

1. Service Sinks, Floor Mounted – see plumbing fixtures schedule on sheet P1.1.

B. Kitchen/Utility Sinks:

1. Kitchen/Utility Sinks, Counter Mounted – see plumbing fixture schedule on sheet P1.1

a. Supply Fittings:

1) Standard: ASME A112.18.1/CSA B125.1.
2) Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

a) Operation: Wheel handle
b) Risers: NPS 1/2, chrome-plated, rigid-copper pipe or ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

b. Waste Fittings:

1) Standard: ASME A112.18.2/CSA B125.2.

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2) Trap(s) Size:[NPS 1-1/2 (DN 40)
3) Trap(s) Material:

a) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to walland chrome-plated brass or steel wall flange.
b) Stainless steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless steel tube to wall; and stainless steel wall flange.

4) Continuous Waste:

a) Size: NPS 1-1/2.
b) Material: Chrome-plated, 17-gauge brass tube.

c. Mounting: On counter with sealant.

C. Sink Supply Fittings:

1. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
2. Standard: ASME A112.18.1/CSA B125.1.
3. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
4. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
5. Operation: Wheel handle
6. Risers:

a. NPS 3/8.
b. Chrome-plated, rigid-copper pipe, Chrome-plated, soft-copper flexible tube, or ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

D. Sink Waste Fittings:

1. Standard: ASME A112.18.2/CSA B125.2.
2. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
3. Trap:

a. Size: NPS 1-1/2.
b. Material:

1) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.

2.4 COMMERCIAL WATER CLOSETS

A. Water Closets, Floor Mounted:

1. Water Closets, Floor Mounted – see plumbing fixture schedule on sheet P1.1.

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2.5 TOILET SEATS

A. Toilet Seats see plumbing fixture schedule on sheet P1.1.
   1. Source Limitations: Obtain toilet seat from single source from single manufacturer.
   2. Material: Plastic.
   3. Type: Commercial (Heavy duty).
   4. Shape: Elongated rim, open front
   5. Seat Cover: Not required.
   6. Color: White

PART 3 - EXECUTION

3.1 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES

A. Lavatory Installation:

   1. Install lavatories level and plumb in accordance with roughing-in drawings.
   2. Install supports, affixed to building substrate, for wall-mounted lavatories.
   3. Install accessible, wall-mounted lavatories at mounting height in accordance with ICC A117.1.
   4. Install water-supply piping with stop on each supply to each lavatory faucet. Install stops in locations that are accessible for ease of operation.
   5. Install trap and waste piping on each drain outlet of each lavatory to be connected to sanitary drainage system.
   6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
   7. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
   8. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

B. Shower Installation:

   1. Assemble shower components in accordance with manufacturers' written instructions.
   2. Install showers level and plumb in accordance with roughing-in drawings.
   3. Install ball or gate valves in water-supply piping to the shower if supply stops are specified with the shower valve. Comply with ball[or gate valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping." Install valves in locations that are accessible for ease of operation.
   4. Install shower flow-control fittings with specified maximum flow rates in shower arms.
   5. Set shower receptors and shower basins in leveling bed of cement grout.
   6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

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7. Seal joints between showers, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

C. Sink Installation:

1. Install sinks level and plumb in accordance with roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-mounted sinks.
3. Install accessible, wall-mounted sinks at mounting height in accordance with ICC A117.1.
4. Set floor-mounted sinks in leveling bed of cement grout.
5. Install water-supply piping with stop on each supply to each sink faucet.
    a. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping."
    b. Install stops/valves in locations that are accessible for ease of operation.
6. Install trap and waste piping on each drain outlet of each sink to be connected to sanitary drainage system.
7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
8. Seal joints between sinks, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

D. Water Closet Installation:

1. Install water closets level and plumb in accordance with roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.
4. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
5. Use carrier supports with waste-fitting assembly and seal.
6. Install floor-mounted, back-outlet water closets, attached to building floor substrate, onto waste-fitting seals; and attach to support.
7. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals, and affix to building substrate.
8. Measure support height installation from finished floor, not structural floor.
9. Install flushometer-valve, water-supply fitting on each supply to each water closet.
10. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
11. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
12. Install actuators in locations easily reachable for people with disabilities.

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13. Install new batteries in battery-powered, electronic-sensor mechanisms.
14. Install toilet seats on water closets.
15. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
16. Seal joints between water closets, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 INSTALLATION OF PIPING CONNECTIONS

A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil, waste, and vent piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible plumbing fixtures. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

E. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.

3.3 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 INSTALLATION OF CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

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B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damages finishes. Replace any fixtures unable to be repaired to the satisfaction of the Owner.

B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224200

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.

1.2 ACTION SUBMITTALS.

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch, or aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of 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.
5. Fasteners: Stainless steel rivets or self-tapping screws.
6. 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, min 1/16 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

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4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of 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.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. 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), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, min **1/16 inch** thick, with predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of 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.

F. Fasteners: Stainless steel rivets or self-taping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

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D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, minimum 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of 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.

F. Fasteners: Stainless steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:

1. Duct size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution ducts. Arrows may be either integral with label or may be applied separately.
3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

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3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of mechanical equipment.

B. Sign and Label Colors:

1. White letters on an ANSI Z535.1 safety-blue background.

C. Locate equipment labels where accessible and visible.

D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF PIPE LABELS

A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.

C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

D. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe-Label Color Schedule:
1. Condenser-Water Piping: White letters on an ANSI Z535.1 safety-green background.
2. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.

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3. Flammable Fluids: Black letters on an ANSI Z535.1 safety-yellow background.
4. Combustible Fluids: White letters on an ANSI Z535.1 safety-brown background.
5. Potable and Other Water: White letters on an ANSI Z535.1 safety-green background.
6. Compressed Air: White letters on an ANSI Z535.1 safety-blue background.

3.5 INSTALLATION OF DUCT LABELS

A. Install plastic-laminated, self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.

1. Provide labels in the following color codes:

a. For air supply ducts: White letters on blue background.
b. For air return ducts: White letters on blue background.
c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on blue background.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:

    a. Constant-volume air systems.
    b. Variable-air-volume systems.

2. Testing, Adjusting, and Balancing of Hydronic Piping Systems:

    a. Constant-flow hydronic systems.
    b. Variable-flow hydronic systems.

3. Testing, adjusting, and balancing of fuel oil systems for HVAC.
4. Testing, adjusting, and balancing of equipment.
5. Testing, adjusting, and balancing of existing HVAC systems and equipment.
6. Procedures for exhaust hoods.
7. Duct leakage tests verification.
8. Pipe leakage tests verification.
9. UFAD plenum leakage tests verification.
10. HVAC-control system verification.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

G. UFAD: Underfloor air distribution.

1.3 ACTION SUBMITTALS

A. Sustainable Design Submittals:

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1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 60 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. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB or TABB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

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1.6 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.

F. Examine equipment performance data, including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

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I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.

L. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.

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j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning in accordance with the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
4. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

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1. Motors.
2. Pumps.
3. Fans and ventilators.
4. Furnaces.
5. Condensing units.
6. Air-handling units.
7. Rooftop air-conditioning units.
8. Packaged air conditioners.
9. Split-system air conditioners.
10. Heat pumps.

3.5 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' Record drawings duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.

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c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report artificial loading of filters at the time static pressures are measured.

3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

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3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
    c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

6. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.

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d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

   a. Balance the return-air ducts and inlets.
   b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:

   a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
   b. Re-measure and confirm that total airflow is within design.
   c. Re-measure final fan operating data, speed, volts, amps, and static profile.
   d. Mark final settings.
   e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
   f. Verify tracking between supply and return fans.

3.8 PROCEDURES FOR MOTORS

A. Motors ½ HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR AIR-COOLED CONDENSERS

A. Verify proper rotation of fan(s).

B. Measure and record entering- and leaving-air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of fan(s) and motor(s).

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3.10 DUCT LEAKAGE TESTS

A. Witness the duct leakage testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.11 PIPE LEAKAGE TESTS

A. Witness the pipe pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.12 UFAD PLENUM LEAKAGE TESTS

A. Witness the UFAD plenum pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.13 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify HVAC control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.14 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

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1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).
2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.
3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
4. Check the refrigerant charge.
5. Check the condition of filters.
6. Check the condition of coils.
7. Check the operation of the drain pan and condensate-drain trap.
8. Check bearings and other lubricated parts for proper lubrication.
9. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than [**5**] <**Insert number**> percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is [**5**] <**Insert number**> percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.15 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm , within 10 cfm.
2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.

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B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.16 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-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**] [**biweekly**] [**monthly**] <**Insert time interval**> 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.

3.17 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

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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 performance forms, including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Heating coil, dry-bulb conditions.
    e. Face and bypass damper settings at coils.
    f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    g. [**Variable-frequency controller**] [**Inlet vane**] settings for variable-air-volume systems.
    h. Settings for pressure controller(s).
    i. Other system operating conditions that affect performance.

16. Test conditions for pump performance forms, including the following:

    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).
    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. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.

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h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and speed.
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.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Inlet and discharge static pressure in inches wg.
e. For each filter bank, filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
j. Outdoor airflow in cfm.
k. Return airflow in cfm.
l. Outdoor-air damper position.
m. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.

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d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and speed.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

H. 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.

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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 speed.
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 speed.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. 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 fan and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

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a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

K. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.18 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.

B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 20 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

F. Prepare test and inspection reports.

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3.19 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 230593

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SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, exposed supply and outdoor air.
   2. Indoor, concealed return located in unconditioned space.
   3. Indoor, exposed return located in unconditioned space.
   4. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
   5. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
   6. Outdoor, concealed supply and return.
   7. Outdoor, exposed supply and return.

B. Related Requirements:

   1. Section 230716 "HVAC Equipment Insulation."
   2. Section 230719 "HVAC Piping Insulation."
   3. Section 233113 "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

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

B. Sustainable Design Submittals:

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
3. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 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 are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral Wool Blanket: Basalt volcanic rock-derived fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C553.

G. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation unfaced Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral Wool Board: Basalt volcanic rock-derived fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1100 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.

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2.3 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a [**1**] [**2**]-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.
   1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
   4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Materials are compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
   1. Materials are compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.

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4. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
6. ASJ+: All-service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII
7. PSK Jacket: Aluminum foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C921, 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 D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White

D. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Sheet and roll stock ready for shop or field sizing.
2. Finish and thickness are indicated in field-applied jacket schedules.
3. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper, 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper, or 3-mil- (0.075-mm-) thick polysurlyn.
4. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper, 3-mil- thick polysurlyn.

E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with [**white**] [**stucco-embossed**] aluminum-foil facing.

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F. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
3. Aluminum Finish: [**Embossed**] [**Smooth**].

2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2.
5. Tensile Strength: 40 lbf/inch in width.
6. 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. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

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2.11 SECUREMENTS

A. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. 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. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
   b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
   c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   b. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
   c. Adhesive-backed base with a peel-off protective cover.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel, aluminum or stainless steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

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.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel, or 0.062-inch soft-annealed, galvanized steel.

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2.12 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC in accordance with ASTM D1784, 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 in accordance with ASTM B209 , Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 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, compress, or otherwise damage insulation or jacket.

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. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents[**, unless otherwise approved by the engineer of record**].

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.

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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, but not to the extent of creating wrinkles or areas of compression in the insulation.
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.

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.

3.3 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 Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

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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.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 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 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.

C. 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.

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3.5 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Comply with manufacturer's written installation instructions.

B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

C. Insulate duct access panels and doors to achieve same fire rating as duct.

D. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.6 FINISHES

A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless steel jackets.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. 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 is limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.

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4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, Supply-Air Duct and Plenum Insulation: Glass-fiber, Mineral wool, blanket, or board, 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

B. Concealed, Return-Air Duct and Plenum Insulation: Concealed, Supply-Air Duct and Plenum Insulation: Glass-fiber, Mineral wool, blanket, or board, 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

C. Concealed, Outdoor-Air Duct and Plenum Insulation: Glass-fiber, Mineral wool, blanket, board, 2 inches thick and 1.5 lb/cu. ft. nominal density.

D. Exposed, Supply-Air Duct and Plenum Insulation: Glass-fiber, Mineral wool, blanket, board, 2 inches thick and 1.5 lb/cu. ft. nominal density.

E. Exposed, Return-Air Duct and Plenum Insulation: Glass-fiber, Mineral wool, blanket, board, 2 inches thick and 1.5 lb/cu. ft. nominal density.

F. Exposed, Outdoor-Air Duct and Plenum Insulation: Glass-fiber, Mineral wool, blanket, board, 2 inches thick and 1.5 lb/cu. ft. nominal density.

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Requirements:

1. Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraint devices and installation.
2. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
3. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
4. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
5. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Dimensions of all duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.

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9. Equipment installation based on equipment being used on Project.
10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated Design Submittals:

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, for selecting hangers and supports and seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Welding certificates.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints are to withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. Seismically brace duct hangers and supports in accordance with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems - OSHPD Edition."

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1. Seismic Hazard Level (SHL): D.

C. Seismic Performance: Ductwork to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

1. 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."

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of [**Type 304**] [**Type 316**] stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
3. Where specified for specific applications, all joints are to be welded.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams are to be Pittsburgh lock seams unless otherwise specified for specific application.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
1. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.

D. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish is to be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating is to be applied to the exterior surface.
2. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound is to have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.

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4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: White.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

G. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less.

2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
2. Solvent or Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

C. Fibrous-Glass-Free, Natural-Fiber Duct Liner: Made from partially recycled cotton or polyester products and containing no fiberglass. Airstream surface overlaid with fire-resistant facing to prevent surface erosion by airstream, complying with NFPA 90A or NFPA 90B. Treat natural-fiber products with antimicrobial coating.
1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with ASTM E84; certified by an NRTL.
2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

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D. Polyolefin Duct Liner: Cross-linked, partially open-cell polyolefin foam sheet or roll materials, with reinforced aluminum foil facing and adhesive backing, complying with NFPA 90A or NFPA 90B; sheet (Type II) complying with ASTM C1427.
   1. Foam Core Density: 1.5 pcf.
   2. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.
   3. Minimum Noise Reduction Coefficient (NRC): 0.50 for 3/8-inch thickness, 0.45 for 5/8-inch thickness, 0.55 for 1-inch thickness, 0.55 for 2-1/8-inch thickness.
   4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
   5. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

E. Insulation Pins and Washers:

   1. 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.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel, aluminum, or stainless steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.

F. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

   6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
   7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
   8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

      a. Fan discharges.
      b. Intervals of lined duct preceding unlined duct.
      c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

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9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 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.

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.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

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D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

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PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install fire[, combination fire/smoke,] and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.

M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

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N. Branch Connections: Use lateral or conical branch connections.

3.2 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 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.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT

A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.

B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

C. All ducts exposed to view are to be constructed of stainless steel as per "Duct Schedule" Article. All ducts concealed from view are to be stainless steel as per "Duct Schedule" Article.

D. All joints are to be welded and are to be telescoping, bell, or flange joint as per NFPA 96.

E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS AND OTHER HIGH-HUMIDITY LOCATIONS

A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.

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B. Provide a drain pocket at each low point and at the base of each riser with a 1-inch trapped copper drain from each drain pocket to open site floor drain.

C. Minimize number of transverse seams.

D. Do not locate longitudinal seams on bottom of duct.

3.5 ADDITIONAL INSTALLATION REQUIREMENTS FOR LABORATORY EXHAUST AND FUME HOOD EXHAUST DUCTS

A. Install ducts in accordance with NFPA 45, "Fire Protection for Laboratories Using Chemicals."

B. Install exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to hood or inlet. Where indicated on Drawings, install trapped drain piping.

C. Connect duct to fan, fume hood, and other equipment indicated on Drawings.

3.6 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Single Wall:

1. Ductwork is to be Type 304 stainless steel.
2. Ductwork is to be galvanized steel.

    a. If duct outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 099113 "Exterior Painting."

3. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

3.7 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.

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4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.8 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. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC."

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.

3.9 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. See Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraint installation requirements.

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3.10 DUCTWORK CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.11 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.12 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. Exhaust 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.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

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a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to 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.

3.13 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "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.

E. 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.

F. 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, humidifiers and dehumidifiers, 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.

G. Mechanical Cleaning Methodology:

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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, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.14 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.15 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units

    a. Pressure Class: Positive 1 inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 2
    d. SMACNA Leakage Class for Round and Flat Oval: 2

2. Ducts Connected to Constant-Volume Air-Handling Units

    a. Pressure Class: Positive 2 inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 2.
    d. SMACNA Leakage Class for Round and Flat Oval: 2.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:

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D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 1 inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 2
d. SMACNA Leakage Class for Round and Flat Oval: 2.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2 inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 2.
d. SMACNA Leakage Class for Round and Flat Oval: 2.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 1 inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 8.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2 inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 8.
d. SMACNA Leakage Class for Round and Flat Oval: 8.

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: Conical spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

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SECTION 237416.11 - PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged, small-capacity, rooftop air-conditioning units.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of RTU.

B. Sustainable Design Submittals:

C. Shop Drawings: For each packaged, small-capacity, rooftop air-conditioning unit.

1. Include plans, elevations, sections, and mounting attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

D. Delegated Design Submittals: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Restraint Details: and seismic-detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Sample Warranty: For manufacturer's warranty.

C. Seismic Qualification Data: Certificates, for RTUs, accessories, and components, from manufacturer.

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D. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548 "Vibration and Seismic Controls for HVAC."

E. Source quality-control reports.

F. System startup reports.

G. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of packaged, small-capacity, rooftop air-conditioning unit that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 year(s) from date of Substantial Completion.
2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of RTUs and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE 15 Compliance: For refrigeration system safety.

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. UL Compliance: Comply with UL 1995.

G. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design mounting and restraints for RTUs, including comprehensive engineering analysis.

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1. Design RTU supports to comply with seismic performance requirements.

H. Seismic Performance: RTUs, accessories, and components to withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

A. Unit Casings:

1. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
2. Double-Wall Construction:

a. Outside Casing Wall: Galvanized steel, minimum 18 gauge thick with manufacturer's standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
b. Inside Casing Wall: G90-coated galvanized steel, 0.034 inch thick.
c. Floor Plate: G90 galvanized steel, treadplate, minimum 18 gauge thick.
d. Casing Insulation:

1) Materials: Injected polyurethane foam insulation.
2) Insulation Thickness: 1 inch.
3) Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roof of unit.

3. Airstream Surfaces: Surfaces in contact with airstream to comply with requirements in ASHRAE 62.1.
4. Static-Pressure Classifications:

a. For Unit Sections Upstream of Fans: Minus: 2-inch wg
b. For Unit Sections Downstream and Including Fans: 2-inch wg

5. Panels and Doors:

a. Panels:

1) Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
2) Fasteners: Two or more camlock type for panel lift-out operation. Arrangement to allow panels to be opened against air-pressure differential.
3) Gasket: Neoprene, applied around entire perimeters of panel frames.
4) Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

b. Access Doors:

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1) Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
2) Gasket: Neoprene, applied around entire perimeters of panel frames.
3) Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

c. Locations and Applications:

1) Fan Section: Inspection and access panels.
2) Access Section: Doors.
3) Coil Section: Inspection and access panels.
4) Damper Section: Inspection and access panels.
5) Filter Section: Inspection and access panels large enough to allow periodic removal and installation of filters.
6) Mixing Section: Doors.

B. Fans, Drives, And Motors:

1. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
2. Supply-Air Fans: Centrifugal, rated according to AMCA 210; galvanized or painted steel; mounted on solid-steel shaft.

a. Shafts: With field-adjustable alignment.

1) Turned, ground, and polished hot-rolled steel with keyway.

b. Shaft Bearings:

1) Heavy-duty, self-aligning, pillow-block type with an L-50 bearing life rating> rated life of minimum 100,000 hours according to ABMA 9.

c. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

1) Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

d. Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel or aluminum hub swaged to backplate and fastened to shaft with setscrews.
e. Mounting: For internal vibration isolation and seismic control. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
f. Shaft Lubrication Lines: Extended to a location outside the casing.
g. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch wide by 0.028-inch thick, galvanized-steel sheet.

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1) Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives to comply with UL 181, Class 1.

3. Drives, Direct: Factory-mounted, direct drive.
4. Drives, Belt: Factory-mounted, V-belt drive, with adjustable alignment and belt tensioning, and with [1.5] [1.25] service factor based on fan motor.

a. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
b. Belts: Oil resistant, non-sparking and nonstatic; in matched sets for multiple-belt drives.
c. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.146-inch-thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.

5. Condenser-Coil Fan: Variable-speed propeller, mounted on shaft of permanently lubricated multispeed ECM motors.
6. Motors:

a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."
b. 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.

c. Enclosure Materials: Cast iron.

d. Efficiency: Premium efficient as defined in NEMA MG 1.

.

e. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
f. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

C. Coils:

1. General Requirements for Coils:

a. Comply with AHRI 410.
b. Fabricate coils section to allow for removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
c. Coils to not act as structural component of unit.

2. Supply-Air Refrigerant Coil:

a. Tubes: Copper.
b. Fins:

1) Material: Aluminum

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c. Fin and Tube Joints: Mechanical bond.
d. Headers: Seamless-copper headers with brazed connections.
e. Frames: Galvanized or Stainless steel
f. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

1) Working Pressure: Minimum 300 psig.

3. Outdoor-Air Refrigerant Coil:

a. Tubes: Copper
b. Fins:

1) Material: Aluminum

c. Fin and Tube Joints: Mechanical bond.
d. Headers: Seamless-copper headers with brazed connections
e. Frames: Galvanized or Stainless steel.
f. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

1) Working Pressure: Minimum 300 psig.

D. Refrigerant Circuit Components:

1. Compressor: Hermetic, variable-speed scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
2. Refrigeration Specialties:

a. Refrigerant: R-454B.
b. Expansion valve with replaceable thermostatic element.
c. Refrigerant filter/dryer.
d. Manual-reset high-pressure safety switch.
e. Automatic-reset low-pressure safety switch.
f. Minimum off-time relay.
g. Automatic-reset compressor motor thermal overload.
h. Brass service valves installed in compressor suction and liquid lines.
i. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

E. Air Filtration:

1. Particulate air filtration is specified in Section 234100 "Particulate Air Filtration."
2. Panel Filters:

a. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
b. Filter Unit Class: UL 900.
c. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
d. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

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3. Adhesive, Sustainability Projects: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.
4. Adhesive, LEED for Schools Projects: As recommended by air-filter manufacturer and that complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Dampers:

1. Comply with requirements in Section 230923.12 "Control Dampers."
2. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed blade arrangement with zinc-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate must not exceed 4 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg rated in accordance with AMCA 500D).
3. Barometric relief dampers.
4. Damper Operators: Comply with requirements in Section 230923.12 "Control Dampers."
5. Electronic Damper Operators:

    a. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
    b. Electronic damper position indicator to have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
    c. Operator Motors:

        1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."
        2) Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
        3) 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.

    d. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf
    e. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf.
    f. Size dampers for running torque calculated as follows:

        1) Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
        2) Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
        3) Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
        4) Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
        5) Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.

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6) Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.

g. Coupling: V-bolt and V-shaped, toothed cradle.
h. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
i. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.

G. Electrical Power Connections:

1. RTU to have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

H. Controls:

1. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
2. Basic Unit Controls:

a. Control-voltage transformer.
b. Wall-mounted thermostat or sensor with the following features:

1) Heat-cool-off switch.
2) Fan on-auto switch.
3) Fan-speed switch.
4) Automatic changeover.
5) Adjustable deadband.
6) Degree F indication.
7) Unoccupied-period-override push button.
8) Data entry and access port to input temperature set points, occupied and unoccupied periods, and output room temperature, supply-air temperature, operating mode, and status.

c. Annunciator Panel for Each Unit:

1) Configuration: Remote wall mounted.
2) Lights to indicate power on, cooling, heating, fan running, filter dirty, and unit alarm or failure.
3) DDC controller or programmable timer and interface with HVAC instrumentation and control system.
4) Digital display of outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.

3. Controller:

a. Type: Electronic
b. Controller to have volatile-memory backup.
c. Safety Control Operation:

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1) Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire-alarm control panel.
2) Firestats: Stop fan and close outdoor-air damper if air greater than 130 deg F enters unit. Provide additional contacts for alarm interface to fire-alarm control panel.
3) Fire-Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence.
4) Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply-air temperature is less than 40 deg F
5) Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.

d. Scheduled Operation: Occupied and unoccupied periods on seven day clock with a minimum of two programmable periods per day.
e. Unoccupied Period:

1) Heating Setback: 10 deg F.
2) Cooling Setback: System off.
3) Override Operation: Two hours.

f. Supply Fan Operation:

1) Occupied Periods: Run fan continuously.
2) Unoccupied Periods: Cycle fan to maintain setback temperature.

g. Refrigerant Circuit Operation:

1) Occupied Periods: Cycle or stage compressors to match compressor output to cooling load to maintain room temperature. Cycle condenser fans to maintain maximum hot-gas pressure.
2) Unoccupied Periods: Compressors off
3) Switch reversing valve for heating or cooling mode on air-to-air heat pump.

h. Gas Furnace Operation:

1) Occupied Periods: Stage burner to maintain room temperature.
2) Unoccupied Periods: Cycle burner to maintain setback temperature.

i. Fixed Minimum Outdoor-Air Damper Operation:

1) Occupied Periods: Open to 25 percent.
2) Unoccupied Periods: Close the outdoor-air damper.

j. Economizer Outdoor-Air Damper Operation:

1) Morning warm-up and cool-down cycles.
2) Occupied Periods: Open to 10 percent fixed minimum intake, and maximum 100 percent of the fan capacity. Controller is to permit air-side economizer operation when outdoor air is less than 60 deg F. Use outdoor-air temperature to adjust mixing dampers. Start relief-air fan with end **switch**

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on outdoor-air damper. During economizer cycle operation, lock out cooling.

3) Unoccupied Periods: Close outdoor-air damper and open return-air damper.

k. Terminal-Unit Relays:

1) Provide heating- and cooling-mode changeover relays compatible with terminal control system required in Section 233600 "Air Terminal Units" and Section 230923 "Direct Digital Control (DDC) System for HVAC."

4. Interface Requirements for HVAC Instrumentation and Control System:

a. Interface relay for scheduled operation.
b. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
c. Provide BACnet or LonWorks compatible interface for central HVAC control workstation for the following:

1) Adjusting set points.
2) Monitoring supply fan start, stop, and operation.
3) Inquiring data to include outdoor-air damper position, supply- and room-air temperature.
4) Monitoring occupied and unoccupied operations.
5) Monitoring constant and variable motor loads.
6) Monitoring variable-frequency drive operation.
7) Monitoring cooling load.
8) Monitoring economizer cycles.
9) Monitoring air-distribution static pressure and ventilation air volume.

I. Roof Curbs:

1. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

a. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1) Materials: ASTM C1071, Type I or II.
2) Thickness: 1 inch

b. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

1) Liner Adhesive: Comply with ASTM C916, Type I.
2) Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.

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3) Liner materials applied in this location to have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.

3. Curb Dimensions: Height of 14 inches

J. Accessories:

1. Electric heater with integral thermostat maintains minimum 50 deg F temperature in gas burner compartment.
2. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet is to be energized even if the unit main disconnect is open.
3. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
4. Remote potentiometer to adjust minimum economizer damper position.
5. Return-air bypass damper.
6. Factory- or field-installed, demand-controlled ventilation.
7. Safeties:

    a. Smoke detector.
    b. Condensate overflow switch.
    c. Phase-loss reversal protection.
    d. High and low pressure control.
    e. Electric coil airflow-proving switch.

8. Coil guards of painted, galvanized-steel wire.
9. Hail guards of galvanized steel, painted to match casing.
10. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.
11. Door switches to disable heating or reset set point when open.
12. Outdoor-air intake weather hood[with moisture eliminator].
13. Oil separator.
14. Service Lights and Switch: Factory installed in fan section with weatherproof cover. Factory wire lights to a single-point field connection.

2.3 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

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D. Aluminum: ASTM B209.

2.4 SOURCE QUALITY CONTROL

A. AHRI Compliance:

1. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs.
2. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
3. Comply with AHRI 270 for testing and rating sound performance for RTUs.
4. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.

B. AMCA Compliance:

1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
2. Damper leakage tested according to AMCA 500-D.
3. Operating Limits: Classify according to AMCA 99.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

B. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.

C. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

3.2 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to RTU, allow space for service and maintenance.

C. Connect piping to unit mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4, ASTM B88, Type M copper tubing. Extend to nearest equipment or roof drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

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E. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.

3.3 DUCT CONNECTIONS

A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

3.4 ELECTRICAL CONNECTIONS

A. Connect electrical wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate is to be laminated acrylic or melamine plastic signs as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate is to be laminated acrylic or melamine plastic signs as layers of black with engraved white letters at least 1/2 inch high.
3. Locate nameplate where easily visible.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections[with the assistance of a factory-authorized service representative.

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C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
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.

D. RTU will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 DEMONSTRATION

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

END OF SECTION 237416.11

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SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. cd: Candela, the SI fundamental unit of luminous intensity.
17. CO/ALR: Copper-aluminum, revised.
18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).
28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.
30. EMF: Electromotive force.
31. EMI: Electromagnetic interference.
32. EPM: Electrical preventive maintenance.
33. EPS: Emergency power supply.

34. EPSS: Emergency power supply system.
35. ESS: Energy storage system.
36. EV: Electric vehicle.
37. EVPE: Electric vehicle power export equipment.
38. EVSE: Electric vehicle supply equipment.
39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
40. FLC: Full-load current.
41. ft: Foot.
42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
43. GEC: Grounding electrode conductor.
44. GFCI: Ground-fault circuit interrupter.
45. GFPE: Ground-fault protection of equipment.
46. GND: Ground.
47. HACR: Heating, air conditioning, and refrigeration.
48. HDPE: High-density polyethylene.
49. HID: High-intensity discharge.
50. HP or hp: Horsepower.
51. HVAC: Heating, ventilating, and air conditioning.
52. Hz: Hertz.
53. IBT: Intersystem bonding termination.
54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
56. IR: Infrared.
57. IS: Intrinsically safe.
58. IT&R: Inspecting, testing, and repair.
59. ITE: Information technology equipment.
60. kAIC: Kiloampere interrupting capacity.
61. kcmil or MCM: One thousand circular mils.
62. kV: Kilovolt.
63. kVA: Kilovolt-ampere.
64. kVAr or kVAR: Kilovolt-ampere reactive.
65. kW: Kilowatt.
66. kWh: Kilowatt-hour.
67. LAN: Local area network.
68. lb: Pound (weight).
69. lbf: Pound (force).
70. LCD: Liquid-crystal display.
71. LCDI: Leakage-current detector-interrupter.
72. LED: Light-emitting diode.
73. Li-ion: Lithium-ion.
74. lm: Lumen, the SI derived unit of luminous flux.
75. LNG: Liquefied natural gas.
76. LP-Gas: Liquefied petroleum gas.
77. LRC: Locked-rotor current.
78. LV: Low voltage.

79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
80. m: Meter.
81. MCC: Motor-control center.
82. MDC: Modular data center.
83. MG set: Motor-generator set.
84. MIDI: Musical instrument digital interface.
85. MLO: Main lugs only.
86. MV: Medium voltage.
87. MVA: Megavolt-ampere.
88. mW: Milliwatt.
89. MW: Megawatt.
90. MWh: Megawatt-hour.
91. NC: Normally closed.
92. Ni-Cd: Nickel-cadmium.
93. Ni-MH: Nickel-metal hydride.
94. NIU: Network interface unit.
95. NO: Normally open.
96. NPT: National (American) standard pipe taper.
97. OCPD: Overcurrent protective device.
98. ONT: Optical network terminal.
99. PC: Personal computer.
100. PCS: Power conversion system.
101. PCU: Power-conditioning unit.
102. PF or pf: Power factor.
103. PHEV: Plug-in hybrid electric vehicle.
104. PLC: Programmable logic controller.
105. PLFA: Power-limited fire alarm.
106. PoE: Power over Ethernet.
107. PV: Photovoltaic.
108. PVC: Polyvinyl chloride.
109. pW: Picowatt.
110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
111. RMS or rms: Root-mean-square.
112. RPM or rpm: Revolutions per minute.
113. SCADA: Supervisory control and data acquisition.
114. SCR: Silicon-controlled rectifier.
115. SPD: Surge protective device.
116. sq.: Square.
117. SWD: Switching duty.
118. TCP/IP: Transmission control protocol/Internet protocol.
119. TEFC: Totally enclosed fan-cooled.
120. TR: Tamper resistant.
121. TVSS: Transient voltage surge suppressor.
122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
123. UL CCN: UL Category Control Number.
124. UPS: Uninterruptible power supply.
125. USB: Universal serial bus.
126. UV: Ultraviolet.
127. V: Volt, unit of electromotive force.
128. V(ac): Volt, alternating current.
129. V(dc): Volt, direct current.
130. VA: Volt-ampere, unit of complex electrical power.

131. VAR: Volt-ampere reactive, unit of reactive electrical power.
132. VFC: Variable-frequency controller.
133. VOM: Volt-ohm-multimeter.
134. VPN: Virtual private network.
135. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
136. W: Watt, unit of real electrical power.
137. Wh: Watt-hour, unit of electrical energy usage.
138. WPT: Wireless power transfer.
139. WPTE: Wireless power transfer equipment.
140. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit.
7. EPEC-40: Schedule 40 electrical HDPE underground conduit.
8. EPEC-80: Schedule 80 electrical HDPE underground conduit.
9. EPEC-A: Type A electrical HDPE underground conduit.
10. EPEC-B: Type B electrical HDPE underground conduit.
11. ERMC: Electrical rigid metal conduit.
12. ERMC-A: Aluminum electrical rigid metal conduit.
13. ERMC-S: Steel electrical rigid metal conduit.
14. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
15. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
16. ERMC-SS: Stainless steel electrical rigid metal conduit.
17. FMC: Flexible metal conduit.
18. FMC-A: Aluminum flexible metal conduit.
19. FMC-S: Steel flexible metal conduit.
20. FMT: Steel flexible metallic tubing.
21. FNMC: Flexible nonmetallic conduit. See "LFNC."
22. HDPE: See EPEC.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERMC-S-G.
38. RMC: See ERMC.

39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.

39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:

1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
4. SEOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.

6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
12. SJOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
24. STOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."

    a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.

2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

    a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
    b. Concrete Box: A box intended for use in poured concrete.
    c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
    d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
    e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
    f. Device Box: A box with provisions for mounting a wiring device directly to the box.
    g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
    h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
    i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
    j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.

k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
o. Raised-Floor Box: A floor box intended for use in raised floors.
p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.
12. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.

    a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.

13. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
14. Jacket: A continuous nonmetallic outer covering for conductors or cables.
15. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the

power supply. It may also include parts to protect the light source or the ballast or to distribute the light.

16. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
17. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
18. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
19. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
20. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
21. Sheath: A continuous metallic covering for conductors or cables.
22. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
23. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
    c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
    d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
    e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
    f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.

24. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

Coordinate this article with Section 011100 "Summary of Work" to avoid conflicting requirements for utility service interruptions.

Retain "Interruption of Existing Electrical Service" Paragraph below if interruption of existing electrical service is required.

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.
3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:

a. Exercising generators.
b. Emergency lighting.
c. Elevators.
d. Fire-alarm systems.

Specify temporary utility requirements in Division 01.

B. Arrange to provide temporary electrical power in accordance with requirements specified in Division 01.

Coordinate first subparagraph below with "Substitution Limitations for Electrical Equipment" Article.

1.4 ACTION SUBMITTALS

Action submittals are submittals requiring responsive action and return of reviewed documents to Contractor.

Coordinate this article with Section 013100 "Project Management and Coordination" to avoid conflicting requirements for coordination drawings.

Retain "Coordination Drawings for Structural Supports" Paragraph below for situations where limited space necessitates maximum use for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. This additional coordination may be especially warranted when heavy equipment, raceways, cable trays, or piping is suspended below large ductwork, or when the existing condition of roof trusses are hidden prior to construction.

Retain "Coordination Drawings for Ceiling Areas" Paragraph below when Project conditions require review and approval of congested or exposed ceiling-mounted systems and equipment by Owner, Tenant, or Designer before installation. Indicate on drawings the locations where coordination drawings for ceiling areas are required. Coordinate drawing locations with Architect.

1.5 INFORMATIONAL SUBMITTALS

A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
1. Submission of specified coordination drawings.
2. Submission of action submittals specified in Division 26.
3. Orders placed for major electrical equipment.
4. Arrival of major electrical equipment on-site.
5. Preinstallation meetings specified in Division 26.
6. Closing of walls and ceilings containing electrical Work.
7. System startup, testing, and commissioning activities for emergency lighting.
8. Requests for inspections by authorities having jurisdiction.

B. Delegated Design Drawings for Structural Masonry Wall Penetrations: Where indicated on Drawings, provide reflected ceiling plan(s), supplemented by elevations, sections, and other details, drawn to scale, signed and sealed by a qualified structural professional engineer, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Location and dimensions of structural members supporting wall.
2. Location and dimensions of columns near penetrations.
3. Location and dimension of headers and lintels.
4. Doors and windows near penetrations.
5. Location and dimensions of penetrating cuts.
6. Sprinkler piping and sleeves.
7. Plumbing piping and sleeves.
8. Ductwork and sleeves.
9. Cable tray and sleeves.
10. Conduit and sleeves.
11. Firestopping assemblies for rated penetrations.
12. Structural supports for piping, ductwork, and conduit on both sides of wall.

C. Certificates:

1. Welding certificates.

1.6 CLOSEOUT SUBMITTALS

A. Facility EPM Program Binders:

1. Complete Set: On approved online or cloud solution.

B. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system.

2. Include the following information:

a. Manufacturer's operating specifications.
b. User's guides for software and hardware.
c. Schedule of maintenance material items recommended to be stored at Project site.
d. Detailed instructions covering operation under both normal and abnormal conditions.
e. Manufacturer's instructions for setting field-adjustable components.

1.7 QUALIFICATIONS

A. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.

B. Structural Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering, including seismic- and wind-load modeling and analysis.

C. Welder: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," with training and certification in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

A. Substitution requests for electrical equipment will be entertained under the following conditions:

1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.2 CLOSEOUT ACTIVITIES

A. Demonstration:

1. Demonstrate to Owner's maintenance and clerical personnel and building occupants how to operate the following systems and equipment:

    a. Lighting control devices.

2. Provide video recordings of demonstrations to Owner.
    a. How to adjust, operate, and maintain Lighting Control Devices.
    b. How to adjust, operate, and maintain equipment specified in Section 263213.13 "Diesel-Engine-Driven Generator Sets."

3. Provide video recordings of training sessions to Owner.

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Connectors and splices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Belden Inc.
3. Cerro Wire LLC.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. General Cable; General Cable Corporation.
7. Senator Wire & Cable Company.
8. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:
1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Cerro Wire LLC.
3. Encore Wire Corporation.
4. General Cable Technologies Corporation.
5. General Cable; General Cable Corporation.
6. Senator Wire & Cable Company.
7. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multicircuit with color-coded conductors.

E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Steel, interlocked.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. AFC Cable Systems, Inc.
3. Gardner Bender.
4. Hubbell Power Systems, Inc.
5. Ideal Industries, Inc.
6. ILSCO.
7. NSi Industries LLC.
8. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
9. Tyco Electronics Corp.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Aluminum.
2. Type: One hole with standard barrels.
3. Termination: **Crimp**.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; stranded.

B. Branch Circuits:

1. Copper. stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway Metal-clad cable, Type MC.

E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, 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, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 9 inch (180 mm) of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors:

3. Perform each of the following visual and electrical tests:

   a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
   b. Test bolted connections for high resistance using one of the following:

      1) A low-resistance ohmmeter.
      2) Calibrated torque wrench.

   c. Inspect compression-applied connectors for correct cable match and indentation.
   d. Inspect for correct identification.
   e. Inspect cable jacket and condition.
   f. Continuity test on each conductor and cable.
   g. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

3. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Slotted support systems, hardware, and accessories.
b. Clamps.
c. Hangers.
d. Sockets.
e. Eye nuts.
f. Fasteners.
g. Anchors.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inch (200 mm) on center in at least one surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper B-Line, Inc.; a division of Cooper Industries.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel
4. Channel Width: 1-5/8 inch (41.25 mm).

5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1) Empire Tool and Manufacturing Co., Inc.
2) Hilti Inc.
3) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
4) MKT Fastening, LLC.

2. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless] steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1) 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 are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
6. Toggle Bolts: All steel springhead type.
7. Hanger Rods: Threaded steel.

F.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101

B. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch (38 mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT IMC and ERMC may be supported by openings through structure members, in accordance with 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 must be weight of supported components plus 200 lb (90 kg).

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 inch (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch (100 mm) thick.
6. To Steel: Beam clamps (MSS SP-58, 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.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.4 PAINTING

A. Touchup:

1. 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.

a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type EMT-S raceways and elbows.
2. Type ERMC-S raceways, elbows, couplings, and nipples.
3. Type FMC-S raceways.
4. Type LFMC raceways.
5. Fittings for conduit, tubing, and cable.
6. Threaded metal joint compound.
7. Metallic outlet boxes, device boxes, rings, and covers.
8. Junction boxes, pull boxes, and miscellaneous enclosures.
9. Cover plates for device boxes.
10. Hoods for outlet boxes.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
1. Cabinets, cutout boxes, and miscellaneous enclosures.

PART 2 - PRODUCTS

a.

2.2 TYPE EMT-S RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797 and UL Category Control Number FJMX.

B. Steel Electrical Metal Tubing (EMT-S) and Elbows:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Anamet Electrical, Inc.
c. Electri-Flex Company.
d. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
e. Patriot Aluminum Products, LLC.

f. Picoma Industries.
g. Republic Conduit.
h. Robroy Industries.
i. Western Tube and Conduit Corporation.
j. Wheatland Tube Company.

2. Material: Steel.
3. Options:

a. Exterior Coating: Zinc.
b. Interior Coating: Zinc with organic top coating.
c. Minimum Trade Size: Metric designator 16 (trade size 1/2).

2.3 TYPE ERMC-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 6 and UL Category Control Number DYIX.

B. Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Anamet Electrical, Inc.
c. Electri-Flex Company.
d. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
e. Patriot Aluminum Products, LLC.
f. Picoma Industries.
g. Republic Conduit.
h. Robroy Industries.
i. Western Tube and Conduit Corporation.

2. Exterior Coating: Zinc.
3. Options:

a. Interior Coating: Zinc with organic top coating.
b. Minimum Trade Size: Metric designator 16 (trade size 1/2).

2.4 TYPE FMC-S RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1 and UL Category Control Number DXUZ.

B. Steel Flexible Metal Conduit (FMC-S):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems, Inc.
    b. Allied Tube & Conduit.
    c. Anamet Electrical, Inc.
    d. Electri-Flex Company.
    e. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
    f. Picoma Industries.
    g. Republic Conduit.
    h. Robroy Industries.
    i. Western Tube and Conduit Corporation.
    j. Wheatland Tube Company.

2. Material: Steel.
3. Options:

    a. Minimum Trade Size: Metric designator 16 (trade size 1/2).
    b.

2.5 TYPE LFMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems, Inc.
    b. Allied Tube & Conduit.
    c. Anamet Electrical, Inc.
    d. Electri-Flex Company.
    e. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
    f. Picoma Industries.
    g. Republic Conduit.
    h. Robroy Industries.
    i. Western Tube and Conduit Corporation.
    j. Wheatland Tube Company.

2. Material: Steel.
3. Options:

    a. Minimum Trade Size: Metric designator 16 (trade size 1/2).

2.6 FITTINGS FOR CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type ERMC, Type PVC Raceways:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Anamet Electrical, Inc.
c. Electri-Flex Company.
d. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
e. Picoma Industries.
f. Republic Conduit.
g. Robroy Industries.
h. Western Tube and Conduit Corporation.
i. Wheatland Tube Company.

2. General Characteristics: UL 514B and UL Category Control Number DWTT.

C. Fittings for Type EMT Raceways:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Anamet Electrical, Inc.
c. Electri-Flex Company.
d. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
e. Picoma Industries.
f. Republic Conduit.
g. Robroy Industries.
h. Western Tube and Conduit Corporation.
i. Wheatland Tube Company.

2. General Characteristics: UL 514B and UL Category Control Number FKAV.
3. Options:

a. Material: Steel.

D. Fittings for Type FMC Raceways:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Anamet Electrical, Inc.
c. Electri-Flex Company.
d. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
e. Picoma Industries.
f. Republic Conduit.
g. Robroy Industries.
h. Western Tube and Conduit Corporation.

i. Wheatland Tube Company.

2. General Characteristics: UL 514B and UL Category Control Number ILNR.

E. Fittings for Type LFMC and Type LFNC Raceways:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Anamet Electrical, Inc.
c. Electri-Flex Company.
d. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
e. Picoma Industries.
f. Republic Conduit.
g. Robroy Industries.
h. Western Tube and Conduit Corporation.
i. Wheatland Tube Company.

2. General Characteristics: UL 514B and UL Category Control Number DXAS.

2.7 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 2419 and UL Category Control Number FOIZ.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy
2. Crouse-Hinds
3. Kopr-Shield
4. Sanchem
5. Thomas & Betts

2.8 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514A and UL Category Control Number QCIT.

B. Metallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB / Thomas & Betts.
    b. Cooper Technologies Company.
    c. RACO; Hubbell.

3. Options:

    a. Material: Sheet steel.

C. Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Adalet.
    b. Cooper Technologies Company.
    c. EGS/Appleton Electric.
    d. Erickson Electrical Equipment Company.
    e. Hubbell Incorporated.
    f. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
    g. Robroy Industries.

D. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB / Thomas & Betts.
    b. Cooper Technologies Company.
    c. RACO; Hubbell.

3. Options:

    a. Material: Sheet steel.

E. Metallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB / Thomas & Betts.
    b. Cooper Technologies Company.
    c. RACO; Hubbell.

2.9 JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

a. Non-Environmental Characteristics: UL 50.
b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB / Thomas & Betts.
b. Cooper Technologies Company.
c. RACO; Hubbell.

3. Additional Characteristics: UL Category Control Number BGUZ.

C. Indoor Sheet Metal Miscellaneous Enclosures:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB / Thomas & Betts.
b. Cooper Technologies Company.
c. Hoffman
d. RACO; Hubbell.

D. Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB / Thomas & Betts.
b. Cooper Technologies Company.
c. Hoffman
d. RACO; Hubbell.

3. Additional Characteristics: UL Category Control Number BGUZ.
4. Options:

a. Degree of Protection: Type 3R.

E. Outdoor Sheet Metal Miscellaneous Enclosures:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB / Thomas & Betts.
b. Cooper Technologies Company.
c. Hoffman
d. RACO; Hubbell.

2. Options:

a. Degree of Protection: Type 3R.

2.10 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
b. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Metallic Cover Plates for Device Boxes:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
b. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
c. Legrand
d. Leviton Mfg. Company Inc. (Leviton).
e. Pass & Seymour/Legrand (Pass & Seymour).
f. Wallplate Material: 0.032 inch (0.8 mm) thick Type 302/304 non-magnetic stainless steel with brushed finish .

C. Nonmetallic Cover Plates for Device Boxes:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
b. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
c. Legrand
d. Leviton Mfg. Company Inc. (Leviton).
e. Pass & Seymour/Legrand (Pass & Seymour).
f. Wallplate Material: 0.060 inch (1.5 mm) thick high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.

2.11 HOODS FOR OUTLET BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

a. Reference Standards:

1) UL 514D and UL Category Control Numbers QCIT and QCMZ.
2) Receptacle, hood, cover plate, gaskets, and seals comply with UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.

b. Mounts to box using fasteners different from wiring device.

B. Retractable or Reattachable Hoods for Outlet Boxes:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
b. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
c. Legrand
d. Leviton Mfg. Company Inc. (Leviton).
e. Pass & Seymour/Legrand (Pass & Seymour).

2. Options:

a. Provides weatherproof, "while-in-use" cover.

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.

B. Outdoors:

1. Exposed and Subject to Severe Physical Damage: ERMC.
2. Exposed and Subject to Physical Damage: ERMC Corrosion-resistant EMT.

a. Locations less than 2.5 m (8 ft) above finished floor.

3. Exposed and Not Subject to Physical Damage: ERMC Corrosion-resistant EMT.
4. Concealed Aboveground: ERMC EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

C. Indoors:

1. Hazardous Classified Locations: ERMC.
2. Exposed and Subject to Severe Physical Damage: ERMC. Subject to severe physical damage includes the following locations:

a. Loading docks.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.
d. Gymnasiums.

3. Exposed and Subject to Physical Damage: ERMC EMT. Subject to physical damage includes the following locations:

    a. Locations less than 2.5 m (8 ft) above finished floor.

4. Exposed and Not Subject to Physical Damage: ERMC EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: ERMC EMT.
6. Damp or Wet Locations: ERMC Corrosion-resistant EMT.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC FMC.

D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC: Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:

    a. Type 3R unless otherwise indicated.
    b. Locations Exposed to Hosedown: Type 4.

2. Indoors:

    a. Type 1 unless otherwise indicated.
    b. Damp or Dusty Locations: Type 4.
    c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
    d. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
    e. Locations Exposed to Hosedown: Type 4.

3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.

6. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
7. Raceway Terminations at Locations Subject to Moisture or Vibration:

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
3. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
4. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:

    a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    b. Where an underground service raceway enters a building or structure.
    c. Conduit extending from interior to exterior of building.
    d. Conduit extending into pressurized duct and equipment.
    e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    f. Where otherwise required by NFPA 70.

5. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
6. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.
7. Keep raceways at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
8. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
9. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inch (300 mm) of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Type ERMC:

    a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

2. Types FMC, LFMC:

a. Comply with NEMA RV 3. Provide a maximum of 72 inch (1830 mm) of flexible conduit for recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

D. Stub-ups to Above Recessed Ceilings:

1. Provide EMT, or ERMC for raceways.
2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

E. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
1. EMT: Provide setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

F. Expansion-Joint Fittings:

1. Install in runs of aboveground ERMC and EMT conduit that are located where environmental temperature change may exceed 100 deg F (55 deg C) and that have straight-run length that exceeds 100 ft (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:

3. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

G. Raceways Penetrating Rooms or Walls with Acoustical Requirements:

1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty.

3.4 INSTALLATION OF BOXES AND ENCLOSURES

A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

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 center of box unless otherwise indicated.

C. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

D. Locate boxes so that cover or plate will not span different building finishes.

E. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.

F. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.

G. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.

H. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

I. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
2. Provide gaskets for wallplates and covers.

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.7 CLEANING

A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Tapes and stencils.
3. Tags.
4. Signs.
5. Cable ties.
6. Miscellaneous identification products.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Labels.
2. Tapes and stencils.
3. Tags.
4. Cable ties.
5. Miscellaneous identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:

C. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

D. Comply with NFPA 70E requirements for arc-flash warning labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
2. Colors for 208Y/120 V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Neutral: White

3. Colors for 240Delta/120 V Circuits:

a. Phase A: Black.
b. Phase B: Orange.
c. Phase C: Blue.
d. Neutral: White

4. Colors for 240 V single phase Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Neutral: White

5. Colors for 480Y/277 V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.
d. Neutral: Gray

6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with two or more yellow stripes.

B. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

C. Warning labels and signs must 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 3 FEET MINIMUM."

D. Equipment Identification Labels:

1. Black letters on white field.

2.3 LABELS

A. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. emedco.
c. HellermannTyton.
d. Marking Services, Inc.
e. Panduit Corp.
f. Seton Identification Products; a Brady Corporation company.

B. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3 mil (0.08 mm) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A'n D Cable Products.
b. Brady Corporation.
c. Brother International Corporation.
d. emedco.
e. Grafoplast Wire Markers.
f. HellermannTyton.
g. Ideal Industries, Inc.
h. LEM Products Inc.
i. Marking Services, Inc.
j. Panduit Corp.
k. Seton Identification Products; a Brady Corporation company.

2. Minimum Nominal Size:

a. 1-1/2 by 6 inch (37 by 150 mm) for raceway and conductors.
b. 3-1/2 by 5 inch (76 by 127 mm) for equipment.
c. As required by authorities having jurisdiction.

2.4 TAPES AND STENCILS

A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil (0.08 mm) thick by 1 to 2 inch (25 to 50 mm) wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. emedco.
    d. Marking Services, Inc.

B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch (25 mm).

2.5 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. emedco.
    d. Marking Services, Inc.
    e. Seton Identification Products; a Brady Corporation company.

2.6 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.

H. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.

I. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.

J. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

K. Self-Adhesive Labels:

1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on 1-1/2 inch (38 mm) high label; where two lines of text are required, use labels 2 inch (50 mm) high.

L. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

M. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

N. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

O. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

P. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

Q. Metal Tags:

1. Place in location with high visibility and accessibility.
2. Secure using [general-purpose] [UV-stabilized] [plenum-rated] cable ties.

R. Nonmetallic Preprinted Tags:

1. Place in location with high visibility and accessibility.
2. Secure using [general-purpose] [UV-stabilized] [plenum-rated] cable ties.

S. Write-on Tags:

1. Place in location with high visibility and accessibility.
2. Secure using [general-purpose] [UV-stabilized] [plenum-rated] cable ties.

T. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on 1-1/2 inch (38 mm) high sign; where two lines of text are required, use labels 2 inch (50 mm) high.

U. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Conductors to Be Extended in Future: Attach write-on tags to conductors and list source.

D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.

E. Arc Flash Warning Labeling: Self-adhesive labels.

F. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Outdoor Equipment: Laminated acrylic or melamine sign.

a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
d. Enclosed switches.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.
4. Receptacles with ground-fault protective devices.
5. Connectors, cords, and plugs.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Toggle switches.
2. Single straight-blade receptacles
3. Duplex straight-blade receptacles.
4. Receptacles with GFCI device.
5. Cord connectors.

B. Field Quality-Control Submittals:

1. Field quality-control reports.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES

A. Toggle Switch:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrow Hart, Wiring Devices; Eaton Electrical Sector
b. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
c. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
d. Legrand
e. Leviton Mfg. Company Inc. (Leviton).
f. Pass & Seymour/Legrand (Pass & Seymour).

2. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

a. Reference Standards: UL CCN WMUZ and UL 20.

4. Accessories:

a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

A. Single Straight-Blade Receptacle:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrow Hart, Wiring Devices; Eaton Electrical Sector
b. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
c. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
d. Legrand
e. Leviton Mfg. Company Inc. (Leviton).
f. Pass & Seymour/Legrand (Pass & Seymour).

2. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

4. Accessories:

a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrow Hart, Wiring Devices; Eaton Electrical Sector
b. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
c. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
d. Legrand
e. Leviton Mfg. Company Inc. (Leviton).
f. Pass & Seymour/Legrand (Pass & Seymour).

2. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

a. Reference Standards: UL CCN RTRT and UL 498.

4. Accessories:

a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.4 RECEPTACLES GROUND-FAULT PROTECTIVE DEVICES

A. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrow Hart, Wiring Devices; Eaton Electrical Sector
b. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
c. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
d. Legrand
e. Leviton Mfg. Company Inc. (Leviton).
f. Pass & Seymour/Legrand (Pass & Seymour).

2. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.

4. Accessories:

a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.5 CONNECTORS, CORDS, AND PLUGS

A. Outdoor-Use, Watertight, Sealed Cord Connector:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrow Hart, Wiring Devices; Eaton Electrical Sector
b. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
c. Crouse Hinds
d. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
e. Legrand
f. Leviton Mfg. Company Inc. (Leviton).
g. Pass & Seymour/Legrand (Pass & Seymour).

2. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

a. Reference Standards: UL CCN AXUT and UL 498.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

D. Interfaces with Other Work:

1. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.

3.4 INSTALLATION OF CONNECTORS, CORDS, AND PLUGS

A. Comply with manufacturer's instructions.

3.5 FIELD QUALITY CONTROL OF SWITCHES

A. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.

B. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

3.6 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.

B. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

D. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

E. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

F. Assemble and submit test and inspection reports.

3.7 FIELD QUALITY CONTROL OF CONNECTORS, CORDS, AND PLUGS

A. Tests and Inspections:

1. Perform tests and inspections indicated in manufacturer's instructions.

B. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

3.8 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

B. Connectors, Cords, and Plugs:

1. After installation, protect connectors, cords, and plugs from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
   a. Enclosed switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles. Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified include the following:

1. Ambient temperature adjustment information.

1.5 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

PART 2 - RODUCTS

2.1 MANUFACTURERS

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

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.

3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.
5. Approved equal.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
1. Type RK-5: 250 and 600-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type T: 250-V, zero- to 1200-A and 600-V, zero- to 800-A rating, 200 kAIC , time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
1. Feeders: Class T.
2. Motor Branch Circuits: Class RK5 time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. GFEP: Ground-fault circuit-interrupter for equipment protection.

B. GFLS: Ground-fault circuit-interrupter for life safety.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

1.4 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain products from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. Square D; a brand of Schneider Electric.
3. Approved equal.

B. Type HD, Heavy Duty:

1. Single throw.
2. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
3. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 NONFUSIBLE SWITCHES

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. Square D; a brand of Schneider Electric.
3. Approved equal.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 and 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. Square D; a brand of Schneider Electric.
3. Approved equal.

B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.

C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

D. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers must be rated as indicated on Drawings.

E. MCCBs must be equipped with device for locking in isolated position.

F. Lugs must be suitable for 90 deg C rated wire, sized in accordance with 75 deg C temperature rating in NFPA 70.

G. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
3. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

A. Indoor, Dry and Clean Locations: UL 50E, Type 1.

B. Outdoor Locations: UL 50E, Type 3R.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
2. Install fuses in fusible devices.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Verify correct phase barrier installation.

h. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

B. Tests and Inspections for Molded-Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that unit is clean.
e. Operate circuit breaker to ensure smooth operation.

f. Inspect operating mechanism, contacts, and chutes in unsealed units.

C. Nonconforming Work:

1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.7 PROTECTION

A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION