

DSA SUBMITTAL

DSA Appl #02-122142

**LUTHER BURBANK HIGH SCHOOL
CAFETERIA MODERNIZATION**

3500 Florin Rd., Sacramento, CA 95823

3186071-000

Sacramento City Unified School District

5735 47th Ave., Sacramento, CA 95824



September 18, 2024

HMC Architects

LUTHER BURBANK HIGH SCHOOL CAFETERIA MODERNIZATION
Sacramento City Unified School District
Sacramento, California

DSA Appl #02-122142

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HMC ARCHITECTS
Architect

RW Engineers
Structural Engineer

LP Consulting Engineers, Inc.
Mechanical/Plumbing Engineers

LP Consulting Engineers, Inc.
Electrical Engineer

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NOT APPLICABLE

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SECTION 00 72 00 - GENERAL CONDITIONS

1.01 GENERAL CONDITIONS

- A. The following form of the General Conditions shall be used for Project:
 - 1. The General Conditions for Project are Owner-Provided.
- B. The General Conditions are available upon request.

END OF DOCUMENT

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SECTION 01 26 73 – DSA CONSTRUCTION CHANGE DOCUMENT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing DSA Construction Change Documents for modifications of portions of the project affecting the Structural Safety, Access Compliance, and Fire and Life Safety.

1.02 DEFINITIONS

- A. DSA: Division of the State Architect.

1.03 CONSTRUCTION CHANGE DOCUMENT

- A. Construction Change Document: Architect will submit a Construction Change Document on DSA Form 140 Application for Approval of Construction Change Document to DSA. Upon DSA approval of a Construction Change Document, Architect will notify Contractor to proceed with the change in the Work, for subsequent inclusion in a Change Order.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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DSA CONSTRUCTION CHANGE
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SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
1. RFIs.

1.02 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Owner name.
 2. Owner's Project number.
 3. Name of Architect and Construction Manager.
 4. Architect's Project number.
 5. Date.
 6. Name of Contractor.
 7. RFI number, numbered sequentially.
 8. RFI subject.
 9. Specification Section number and title and related paragraphs, as appropriate.
 10. Drawing number and detail references, as appropriate.
 11. Field dimensions and conditions, as appropriate.
 12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 13. Contractor's signature.
 14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: CSI Form 13 2A or software-generated form with substantially the same content as indicated above, acceptable to Architect.

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- D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect or Construction Manager of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within five days of receipt of the RFI response.
- E. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within three days if Contractor disagrees with response.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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PROJECT MANAGEMENT AND
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SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Cutting and patching.

1.02 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.03 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
 - e. HVAC shutdown and sealing of air intakes.
 - 2. Coordinate work activities with Owner so Owner has adequate advance notice to place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.
 - 3. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.04 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

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1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

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PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Fluid-Applied Flashing and Roofing Membrane: Flexible, PMMA-based resin combined with a thixotropic agent for use in combination with non-woven, needle-punched polyester fabric reinforcement to form a monolithic, reinforced flashing and roofing membrane.
 - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - a. Kemper System; Kemperol AC Speed FR.
 - b. Siplast; Parapro.
 - c. Soprema; Alsan RS.

PART 3 - EXECUTION

3.01 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

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- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 01 10 00 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

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- a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Roofing Membrane Assemblies: Patch roofing membrane penetrations and transitions with reinforced, liquid applied PMMA flashing membrane. Embed roofing granules to match existing roofing granule cap and flashing sheets.
6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

END OF SECTION

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SECTION 01 81 13.71 - SUSTAINABLE DESIGN REQUIREMENTS - CALGREEN
NON-RESIDENTIAL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: General requirements and procedures for compliance with 24 CCR 11, California Green Building Standards Code (CALGreen).
 - 1. Some CALGreen requirements depend on product selections and may not be specifically identified as CALGreen requirements. Compliance with CALGreen requirements may be used as one criterion to evaluate substitution requests and comparable product requests.
 - 2. Some CALGreen requirements depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
 - 3. Additional CALGreen requirements not included in this specification apply to the Project.

1.02 DEFINITIONS

- A. CALGreen: California Green Building Standards Code, including supplements in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. Definitions that are part of CALGreen apply to this Section.

1.03 CONFLICTING REQUIREMENTS

- A. Conflicting Sustainable Design Requirements: In the event of a conflict between Sustainable Design Requirements specification sections, comply with the more stringent requirement.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect about CALGreen requirements that depend on product selection or product qualities. Document responses as informational submittals.
- B. When requested by enforcing agency submit substantiating documentation confirming compliance with CALGreen requirements.
- C. Sustainable design submittals shall be identified and submitted separately from other submittals.

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1.05 INFORMATIONAL SUBMITTALS

A. Sustainable Design Submittals:

1. Documentation for Construction and Demolition Waste Management: Submit documentation complying with CALGreen for one of the following:
 - a. Construction Waste Management Plan.
 - b. Waste Management Company.
 - c. Waste Stream Reduction Alternative.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Construction and Demolition Waste Management: Achieve end-of-Project rates for salvage/recycling of not less than 65 percent of total nonhazardous solid waste generated by the Work. Comply with local construction and demolition waste management ordinance when it is more stringent.
- B. Universal Waste: Universal Waste items such as fluorescent lamps and ballast, and mercury containing thermostats, as well as other California prohibited Universal Waste materials shall be disposed of properly and diverted from landfills.
- C. Site-Clearing Waste: 100 percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled. If contamination by disease or pest infestation is suspected, contact the Country Agricultural Commissioner and follow its direction for recycling or disposal of the material.

2.02 MATERIALS

- A. Provide products and procedures necessary to comply with CALGreen requirements in this Section. Although other Sections may specify some requirements that contribute to referenced CALGreen requirements, determine additional materials and procedures necessary to comply with CALGreen requirements indicated.

2.03 LOW-EMITTING MATERIALS

A. Adhesives and Sealants:

1. For field applications, adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, and caulks shall comply with VOC content limits of authorities having jurisdiction, or the following VOC content limits:
 - a. Indoor Carpet Adhesives: 50 g/L.
 - b. Carpet Pad Adhesives: 50 g/L.
 - c. Outdoor Carpet Adhesives: 150 g/L.

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- d. Wood Flooring Adhesive: 100 g/L.
 - e. Rubber Floor Adhesives: 60 g/L.
 - f. Subfloor Adhesives: 50 g/L.
 - g. Ceramic Tile Adhesives: 65 g/L.
 - h. VCT and Asphalt Tile Adhesives: 50 g/L.
 - i. Gypsum Board and Panel Adhesives: 50 g/L.
 - j. Cove Base Adhesives: 50 g/L.
 - k. Multipurpose Construction Adhesives: 70 g/L.
 - l. Structural Glazing Adhesives: 100 g/L.
 - m. Single-Ply Roof Membrane Adhesive: 250 g/L.
 - n. Other Adhesive Not Specifically Listed: 50 g/L.
 - o. PVC Welding Compounds: 510 g/L.
 - p. CPVC Welding Compounds: 490 g/L.
 - q. ABS Welding Compounds: 325 g/L.
 - r. Plastic Cement Welding Compounds: 250 g/L.
 - s. Adhesive Primer for Plastic: 550 g/L.
 - t. Contact Adhesive: 80 g/L.
 - u. Special-Purpose Contact Adhesive (Contact Adhesive That Is Used to Bond Melamine Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
 - v. Structural Wood Member Adhesives: 140 g/L.
 - w. Top and Trim Adhesive: 250 g/L.
 - x. Metal-to-Metal Adhesives: 30 g/L.
 - y. Plastic Foam Adhesives: 50 g/L.
 - z. Adhesives for Porous Materials (except Wood): 50 g/L.
 - aa. Wood Glues: 30 g/L.
 - bb. Fiberglass Adhesives: 80 g/L.
 - cc. Architectural Sealants: 250 g/L.
 - dd. Nonmembrane Roof Sealants: 300 g/L.
 - ee. Roadway Sealants: 250 g/L.
 - ff. Single-Ply Roof Membrane Sealants: 450 g/L.
 - gg. Other Sealants: 420 g/L.
 - hh. Sealant Primers for Nonporous Substrates: 250 g/L.
 - ii. Sealant Primers for Porous Substrates: 775 g/L.
 - jj. Modified Bituminous Sealant Primers: 500 g/L.
 - kk. Other Sealant Primers: 750 g/L.
2. Prohibited Ingredients: Adhesives and sealants must not contain the following:
- a. Chloroform.
 - b. Ethylene dichloride.
 - c. Methylene chloride.
 - d. Perchloroethylene.
 - e. Trichloroethylene.

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SUSTAINABLE DESIGN
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3. Additional Requirements: Comply with additional requirements in CALGreen for aerosol adhesives, and small unit sizes of adhesives, and sealant or caulking compounds.

B. Paints and Coatings:

1. For field applications, paints and coatings shall comply with VOC limits of California Air Resources Board (CARB) Architectural Coatings Suggested Control Measure (SCM) below, unless more stringent local limits apply. The VOC content limit for coatings that do not meet the definitions for the specialty coatings categories listed shall be determined by classifying the coating as flat, nonflat, or nonflat-high gloss coating, based on its gloss.
 - a. Flat Coatings: 50 g/L.
 - b. Nonflat Coatings: 100 g/L.
 - c. Nonflat - High Gloss Coatings: 150 g/L.
 - d. Specialty Coatings:
 - 1) Aluminum Roof Coatings: 400 g/L.
 - 2) Basement Special Coatings: 400 g/L.
 - 3) Bituminous Roof Coatings: 50 g/L.
 - 4) Bituminous Roof Primers: 350 g/L.
 - 5) Bond Breakers: 350 g/L.
 - 6) Concrete Curing Compounds: 350 g/L.
 - 7) Concrete/Masonry Sealers: 100 g/L.
 - 8) Driveway Sealers: 50 g/L.
 - 9) Dry-Fog Coatings: 150 g/L.
 - 10) Faux Finishing Coatings: 350 g/L.
 - 11) Fire-Resistive Coatings: 350 g/L.
 - 12) Floor Coatings: 100 g/L.
 - 13) Form-Release Compounds: 250 g/L.
 - 14) Graphic Arts Coatings (Sign Paints): 500 g/L.
 - 15) High-Temperature Coatings: 420 g/L.
 - 16) Industrial Maintenance Coatings: 250 g/L.
 - 17) Low Solids Coatings: 120 g/L.
 - 18) Magnesite Cement Coatings: 450 g/L.
 - 19) Mastic Texture Coatings: 100 g/L.
 - 20) Metallic Pigmented Coatings: 500 g/L.
 - 21) Multi-Color Coatings: 250 g/L.
 - 22) Pretreatment Wash Primers: 420 g/L.
 - 23) Primers, Sealers, and Undercoaters: 100 g/L.
 - 24) Reactive Penetrating Sealers: 350 g/L.
 - 25) Recycled Coatings: 250 g/L.
 - 26) Roof Coatings: 50 g/L.
 - 27) Rust-Preventive Coatings: 250 g/L.
 - 28) Shellacs, Clear: 730 g/L.
 - 29) Shellacs, Opaque: 550 g/L.
 - 30) Specialty Primers, Sealers and Undercoaters: 100 g/L.

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SUSTAINABLE DESIGN
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- 31) Stains: 250 g/L.
 - 32) Stone Consolidants: 450 g/L.
 - 33) Swimming Pool Coatings: 340 g/L.
 - 34) Traffic Marking Coatings: 100 g/L.
 - 35) Tub and Tile Refinish Coatings: 420 g/L.
 - 36) Waterproof Membranes: 250 g/L.
 - 37) Wood Coatings: 275 g/L.
 - 38) Wood Preservatives: 350 g/L.
 - 39) Zinc-Rich Primers: 340 g/L.
2. Additional Requirements: Comply with additional requirements in CALGreen for aerosol paints and coatings.
- C. Carpet Systems: All interior carpet materials, including cushion, shall comply with at least one of the following:
1. Carpet and Rug Institute's Green Label Plus program.
 2. VOC-emission limits and testing 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," Version 1.2 (CDPH Standard Method v1.2).
- D. Composite Wood Products: Composite wood products used on the interior or exterior of the building shall have formaldehyde emission rates not greater than the following specified by the California Air Resources Board (CARB), Air Toxics Control Measure (ATCM) for Composite Wood, as tested in accordance with ASTM E1333:
1. Hardwood Plywood (Veneer Core and Composite Core): 0.05 ppm.
 2. Particleboard: 0.09 ppm.
 3. Medium-Density Fiberboard More Than 5/16 Inch Thick: 0.11 ppm.
 4. Medium-Density Fiberboard 5/16 Inch or Less in Thickness: 0.13 ppm.
- E. Resilient Flooring Systems: Where resilient flooring is installed, at least 80 percent of floor area receiving resilient flooring shall meet the requirements comply with the following:
1. VOC-emission limits and testing 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," Version 1.2 (CDPH Standard Method v1.2).
- F. Thermal Insulation: Thermal insulation products shall comply with VOC-emission limits and testing 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," Version 1.2 (CDPH Standard Method v1.2).

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- G. Acoustical Ceilings and Wall Panels: Acoustical ceilings and wall panels shall comply with VOC-emission limits and testing 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," Version 1.2 (CDPH Standard Method v1.2).

PART 3 - EXECUTION

3.01 CONSTRUCTION WASTE MANAGEMENT

- A. Construction and Demolition Waste Management: Achieve specified rates for waste management by one of the following:
1. Construction Waste Management Plan: Where a local jurisdiction does not have a construction and demolition waste management ordinance that is more stringent, submit a construction waste management plan that includes the following:
 - a. Identification of construction and demolition waste materials to be diverted from disposal by efficient usage, recycling, reuse on the Project or salvage for future use or sale.
 - b. Determination of construction and demolition waste materials will be sorted on-site (source separated) or bulk mixed (single stream).
 - c. Identification of diversion facilities where construction and demolition waste material collected will be taken.
 - d. Specification of the amount of construction and demolition waste materials diverted shall be taken by weight or volume, but not by both.
 2. Waste Management Company: Utilize a waste management company that can provide verifiable documentation that the percentage of construction and demolition waste material diverted from the landfill complies with CALGreen.
 3. Waste Stream Reduction Alternative: The combined weight of new construction disposal that does not exceed two pounds per square foot of building area shall be deemed to meet the 65 percent minimum requirement as approved by the enforcing agency.

3.02 CONSTRUCTION IAQ MANAGEMENT

- A. Cover or close openings in ducts and other related air-distribution component openings with tape, plastic, sheet metal, or other approved method before beginning dust-producing operations and maintain until dust-producing operations are complete.
- B. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period, install MERV 8 filter media according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
1. Replace all air filters immediately prior to occupancy.

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END OF SECTION

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SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.

1.02 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- C. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.03 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.04 PREINSTALLATION MEETINGS

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

1.05 QUALITY ASSURANCE

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

1.06 FIELD CONDITIONS

- A. Conduct selective demolition so Owner's operations will not be disrupted.

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- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.07 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.08 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

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PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

3.02 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.03 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

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3.04 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.

- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

- C. Remove temporary barricades and protections where hazards no longer exist.

3.05 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain fire watch during and after flame-cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

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8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- 3.06 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS
- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
- E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

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3.07 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.08 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

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SECTION 03 10 00 - CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Formwork for cast-in place concrete with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.
- E. Related Sections:
 - 1. Section 03 20 00, Concrete Reinforcement.
 - 2. Section 03 30 00, Cast-In Place Concrete.

1.02 REFERENCE STANDARDS

- A. Conform to current adopted reference standards as listed in Chapter 35 the 2022 California Building Code.
- B. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
- D. PS-1 - Construction and Industrial Plywood.
- E. California Code of Regulations, Title 8 Subchapter 4. Construction Safety Orders, Article 29, Erection and Construction, Section 1717.
- F. Chapter 19A, 2022 California Building Code.
- G. APA - American Plywood Association Design and Construction Guide.
- H. CCR - California Code of Regulations, Title 8, Subchapter 4, Construction Safety Orders.
- I. Local AQMD - Air Quality Management District.

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1.03 COORDINATION

- A. Coordinate this Section with other Sections of work that require attachment of components to formwork.

- B. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

PART 2 - PRODUCTS

2.01 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing to conform to Section 26.11, ACI 318. Resultant concrete to conform to required shape, line and dimension. Design of formwork is Contractor's responsibility.

- B. The formwork shall be designed for the loads and lateral pressures outlined in Chapter 2 of ACI 347R, and lateral forces as specified by the CBC.

- C. Forms shall be designed by a professional Structural engineer registered in the State of California.

- D. Foundation concrete may be placed directly into neat excavations, provided foundation trench walls are stable as determined by Architect, subject to approval of DSA and Architect. In such case, minimum formwork indicated on drawings is mandatory to insure clean excavations immediately prior to and during placing of concrete.

2.02 FORM MATERIALS

- A. Plywood: APA - MDO (Medium Density Overlay) Plyform, Group 1, Exterior, PS-1, for exposed surfaces. APA - BB (No-overlay) Plyform, Class 1, Exterior, PS-1 for unexposed surfaces.

- B. Lumber: Douglas Fir species; construction grade with grade stamp clearly visible.

- C. Form Ties: Removable metal of adjustable length, cone ends.

2.03 FORMWORK ACCESSORIES

- A. Form Release Agent: Colorless non-staining liquid chemical agent, free of wax or oils which will not absorb water. Material shall comply with Local AQMD.

- B. Corners: Chamfered type; maximum possible lengths.

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- C. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with Drawings.

3.02 EARTH FORMS

- A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.03 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements in accordance with requirements of ACI 318 Section 26.11.
 - 1. Calculations Required: Provide shoring required to protect all earth banks which cannot be sloped back, due to adjacent structures, walks, streets or property lines. Provide engineering calculations and drawings necessary to perform Work. Calculations to be sealed and signed by licensed California Structural Engineer.
 - 2. Where public areas such as sidewalks and streets are to be shored, drawings and calculations are to be submitted by Contractor to the city or governing agency for approval prior to beginning of any work.
 - 3. Contractor and/or his engineer assume and accept all responsibility for construction and safety of shoring.
 - 4. Upon completion of Work, shoring materials are to be removed from site at expense of Contractor. Certain steel and/or concrete materials may be left in place with written approval of Architect.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shoring. Conform to Title 8, Subchapter 4, Construction Safety Orders, CCR.
- D. Align joints and make watertight. Keep form joints to a minimum.

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- E. Obtain approval before framing openings in structural members that are not indicated on Drawings.
- F. Provide chamfer strips on external corners.

- G. Surface irregularities, ACI 347R Class A, gradual or abrupt irregularities of 1/8 inch for exposed to view concrete. Class B, 1/4 inch for plaster cement finish.

3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.05 INSERTS, EMBEDDED PARTS AND OPENINGS

- A. Provide formed openings where required for items to be embedded in or passing through concrete work. No openings or embedded items permitted in structural slabs within 18 inches of columns. Conform to Section ACI 318 Section 26.11.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate work of other Sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors and other inserts, whether indicated on the structural drawings or not.
- D. Install accessories in accordance with manufacturer's instructions, straight, level and plumb. Ensure items are not disturbed during concrete placement.

3.06 FORM CLEANING

- A. Clean and remove foreign matter within forms as erection proceeds.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

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3.07 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117.

3.08 FIELD QUALITY CONTROL

- A. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design and that supports, fastenings, wedges, ties and items are secure.

3.09 FORM REMOVAL

- A. Conform to Chapter 26, Section 26.11, ACI 318.
- B. Loosen forms carefully. Do not wedge pry bars, hammers or tools against finish concrete surfaces scheduled for exposure to view. Do not break-off corners.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms. Re-shoring permitted only after 10 days and prior to stripping.

END OF SECTION

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SECTION 03 20 00 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Fabricating and setting reinforcing steel and accessories for cast-in-place concrete.
- B. Related Sections:
 - 1. Section 03 10 00, Concrete Formwork.
 - 2. Section 03 30 00, Cast-in-Place Concrete.

1.02 REFERENCE STANDARDS

- A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.
- B. ACI 315 - Details and Detailing of Concrete Reinforcing.
- C. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
- D. ASTM International:
 - 1. ASTM 1064 - Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 2. ASTM A615 - Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
- E. CRSI - Concrete Reinforcing Steel Institute Manual of Practice.
- F. Chapter 19A, 2022 California Building Code.

1.03 SUBMITTALS

- A. Shop Drawings, indicating bar sizes, spacings, locations and quantities of reinforcing steel bending and cutting schedules and supporting and spacing devices.

1.04 QUALITY ASSURANCE

- A. Provide Testing Laboratory with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.

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- B. Comply with the requirements of Division 01, General Requirements.

1.05 COORDINATION

- A. Coordinate with placement of formwork, formed openings and other Work.

PART 2 - PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, deformed billet steel bars, in grades as follows, and conforming to CBC 19A, Section 1903A.
 - 1. For No.4 and larger bars, use 60 ksi yield grade.
 - 2. For ties and stirrups, and No. 3 and smaller bars, use 40 ksi yield grade.

2.02 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16-gauge black annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.
- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.
- D. Concrete Blocks: Approximately 3 inches dimension each side.

2.03 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice, ACI 315 and ACI 318. Wherever possible, make bends to shape in fabricator's shop.
 - 1. Bars reduced in section will not be accepted.
 - 2. Bars with kinks are unacceptable.
 - 3. Bars shall not be heated to facilitate bending or for any other purpose.
 - 4. Bars with bends not indicated on drawings will not be accepted. Perform no forming in a manner which will damage bars.
 - 5. Rebending of bars prohibited.
- B. Locate reinforcing splices not indicated on Drawings at point of minimum stress.

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PART 3 - EXECUTION

3.01 PLACEMENT

- A. General: Comply with CBC and CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Place, support and secure reinforcement against displacement. Do not deviate from required position. Install concrete blocks to support reinforcement over grade. Rocks not permitted.
- C. Do not displace or damage vapor barrier where vapor barrier is specified or indicated on drawings. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- D. Accommodate placement of formed openings.
- E. Prior to placing, thoroughly clean reinforcement of all rust, dirt, dust, oil or any other material deleterious to bonding of concrete.
- F. Accurately place and securely tie reinforcement with black annealed wire and securely hold in position during placing of concrete by means of precast concrete block supports. Point wire tie ends away from the form. Unless otherwise indicated, the number, type, and spacing of supports shall conform to the ACI 315.
 - 1. Tie reinforcement splices and intersections per CBC and CRSI, Chapter 10, General Principles for Placing, Splicing and Tying Reinforcing Bars.
- G. During placing of structural concrete slabs, provide a full-time reinforcing steel placer to repair and replace reinforcing to its proper location. Provide additional chairs of the

proper size available to place under bars displaced during the concrete pouring operation.
- H. Dowels for Walls: Securely tie in place prior to placing of concrete. Do not place dowels in concrete after pour.
- I. Conform to Section 20.6.1.3.1, ACI 318, California Building Code for concrete cover over reinforcement.

END OF SECTION

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DSA SUBMITTAL
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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place concrete.
- B. Concrete curbs for walls, floors and slabs on grade, footings.
- C. Control, expansion and contraction joint devices associated with concrete work including joint sealants.
- D. Concrete for curbs, gutter, sidewalks, stairs and ramps and other site-related concrete is specified in Section 32 13 13.
- E. Related Sections:
 - 1. Section 03 10 00, Concrete Formwork.
 - 2. Section 03 20 00, Concrete Reinforcement.
 - 3. Section 07 92 00, Joint Sealants.
 - 4. Section 32 13 13, Sitework Concrete.

1.02 REFERENCE STANDARDS

- A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of Contract Documents.
- B. CBC - 2022 California Building Code
 - 1. CBC Chapter 19A, Concrete
- C. ADA - Americans with Disabilities Act of 1990, as amended
 - 1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.
- D. American Concrete Institute:
 - 1. ACI 224R - Control of Cracking in Concrete Structures.
 - 2. ACI 224.3R - Joints in Concrete.
 - 3. ACI 301 - Structural Concrete for Buildings.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete and Commentary
- E. ASTM International:

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1. ASTM C33 - Concrete Aggregate.
2. ASTM C150 - Portland Cement.
3. ASTM C171 - Sheet Materials for Curing Concrete.
4. ASTM C330 - Lightweight Aggregates for Structural Concrete.
5. ASTM C 311 - Standard Methods of Sampling and Testing Fly Ash and Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.
6. ASTM C618 - Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Concrete.
7. ASTM C856 - Petrographic Examination of Hardened Concrete.
8. ASTM C1107 - Packaged Dry, Hydraulic - Cement Grout (Nonshrink).
9. ASTM E1155 - Standard Test Method for Determining Floor Flatness and Levelness using the F-Number System.
10. ASTM C567 - Unit Weight of Structural Lightweight Concrete.
11. ASTM C1116 - Specification for Fiber-Reinforced Concrete.
12. ASTM D1751 - Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Bituminous Type).
13. ASTM E96 - Water Vapor Transmission of Materials.
14. ASTM F1869 - Test Method for Measuring Moisture Vapor Emission.
15. ASTM F2170 - Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes.

F. DSA IR 19-3 Interpretation of Regulations, Fly Ash and Natural Pozzolans Used in Concrete.

G. CSS - Caltrans Standard Specifications, Latest Edition.

1.03 SUBMITTALS

- A. Placement Schedule: Submit for approval details and/or sketches showing location of each proposed construction joint. Do not deviate from locations of horizontal joints indicated on drawings.
- B. Product data for each type of manufactured material and product included.
- C. Design mix for each concrete mix.
- D. Steel reinforcement shop drawings, including material, grade bar schedules, spacing, bent bar diagrams, arrangement and supports.
- E. Submit contraction (crack control) joint, expansion, isolation and construction joint layout to Architect for approval.
- F. Project Record Documents:
 1. Accurately record actual locations of embedded utilities and components that are concealed from view.

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2. Maintain an accurate record showing date and time of concrete placement in each portion of structure. Correlate placing record for test cylinders made by testing laboratory. Maintain a separate record giving date of removal of forms, shoring, including first and second halves and reshoring, if used. Keep records available for inspection at site. Upon completion, deliver two copies of each to Architect in approved form.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with Section 1905A.1.16, California Building Code, and ACI 318 Section 26.12.
- B. Maintain one copy of all records.
- C. Acquire cement and aggregate from same source for all work.
- D. Conform to ACI 318 Section 26.5.5, when concreting during hot weather. No concrete placement permitted above 90 degrees Fahrenheit.
- E. Conform to ACI 318 Section 26.5.4 when concreting during cold weather. No concrete placement permitted below 50 degrees Fahrenheit.
- F. Installer Qualifications, Concrete [Stain] [Color]: Minimum 5 years experience with installing stain and color products specified, certified and approved by the manufacturer.

1.05 COORDINATION

- A. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I or II. Portland Cement Type, conforming to Section 1903A, California Building Code.
- B. Aggregates:
 1. Aggregate for Stone Concrete: ASTM C33.
 2. Aggregate for Lightweight Concrete: ASTM C330.

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- C. Conform to requirements specified herein for maximum size of aggregate permitted in individual applications.
- D. Water, ASTM C1602: Clear, from potable source, and not detrimental to concrete.
- E. Fly Ash:
 - 1. Fly ash: may be used at 25% replacement of the Portland cement, at a 1:1 replacement ratio by weight. The fly ash shall meet the requirements of ASTM C 618 with the exception that the Loss on Ignition (LOI is a measure of the loss in mass of a fly ash sample when placed in a 750 degrees C oven) shall not exceed 1.0%. Only Class F material is permitted, CBC Section 1903A.5.
 - 2. When fly ash is used the quantity of water shall be determined on a water-cement plus fly ash basis.
 - 3. Comply with requirements of DSA IR 19-3 fly ash in excess of 15% by weight, per 2022 CBC, Section 1903A.5. including requirement for mix design to bear Civil Engineer's signature and seal.

2.02 ACCESSORIES

- A. Concrete Formwork: In accordance with Section 03 10 00.
- B. Reinforcement: In accordance with Section 03 20 00.
- C. Bonding Agent: ASTM C631, Polyvinyl Acetate Latex emulsion; HIBOND, manufactured by Lambert Corporation, Orlando FL, LOCK BOND NO. 906, manufactured by Macklanburg-Duncan Co., City of Industry, CA, or equal.
- D. Curing Film: ASTM C171; 10 mil thick, clear polyethylene film, single sheet, manufactured from virgin resin with no scrap or additives, free of visible defects, uniform in appearance, conforming to the following:
 - 1. Moisture Loss: 0.055 g per sq. cm.
 - 2. Tensile Strength: 1700 psi longitudinal, 1200 psi transverse.
 - 3. Elongation: 225 percent longitudinal, 350 percent transverse.
- E. Non-Shrink Grout: ASTM C1107, Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5,000 psi in 24 hours and 8,000 psi in 7 days; of consistency suitable for application and a 30-minute working time.
- F. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8" and that can be feathered at edges to match

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adjacent floor elevations. Products by Tile-Tex by Flintkote Co., Webtex #60 or Fixallatex by Dowman Products Co or equal.

- G. Interior/Exterior Compound: ARDEX TILT WALL PATCH or equal as approved in accordance with Division 01 for substitutions., cementitious surface treatment for filling and smoothing interior and exterior vertical concrete surfaces prior to sealing or painting.
- H. Waterstops: Flexible PVC type, factory-installed metal eyelets for embedding in concrete to prevent passage of fluids through joints, factory-fabricated corners, intersections and directional changes. Flat serrated [Serrated] or dumbbell without centerbulb [with centerbulb] for contraction (non-working joints) [for expansion (working joints)] joints, 6 inches, 1/4-inch-thick, unless noted otherwise on drawings. By Greenstreak/Sika, Inc. St. Louis, Missouri, BoMetals Inc. Powder Springs, GA or equal.
- I. Waterstops: Flexible strip, active bentonite/butyl rubber waterstop field installed in concrete to prevent passage of fluids through joints, RX 101 or RX 102 unless noted otherwise on drawings. By Waterstop-RX by Building Materials Group, Greenstreak/Sika, Inc. St. Louis or equal.
- J. Secondary Reinforcement (shrinkage control): Synthetic-fiber-reinforced concrete contains virgin homopolymer polypropylene. Fibrillated polypropylene fibers engineered and designed for use in concrete, complying with ASTM C1116, Type III, 1/2 to 1-1/2 [1-1/2 to 2] inches long by the Forta Corporation, GCP Applied Technologies or equal. Dosage: 1.5 lbs per cubic yard of concrete [0.2%, 3.0 lbs/cu.yd] [0.33%, 5.0% lbs/cu.yd.]

2.03 JOINT DEVICES AND FILLER MATERIALS

- A. Fiber Expansion Joint Filler - ASTM D1751: Closed cell, 1/2 inch max. thick; FIBER EXPANSION JOINT by American Highway Technology, Kankakee, IL, FIBRE EXPANSION JOINT or DECK-O-FOAM by W. R. Meadows, Dayton Superior or approved equal.
- B. Expansion Joint Top: Integral extruded polystyrene plastic; 1/2 inch thick, with removable top strip exposing sealant trough, JOINT CAPS manufactured by The Burke Company, or equal.
- C. Primer: As recommended by sealant manufacturer.
- D. Joint Backing: ASTM C1330, Cylindrical, Type C, closed cell, polyethylene backer rod; oversized 30 to 50 percent larger than joint width. Green Rod by Nomaco Inc. or equal.
- E. Sealant: Polyurethane two-component type, self-leveling, for level surface application, UREXPAN NR-200 or DYNATRED for sloped surfaces, manufactured by Pecora Corp., Harleysville PA, or equal. Color shall be selected by Architect.

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- F. Saw-Cut Joint Filler: Two-component epoxy resin, gray color, non-hardening, self-leveling, SIKADUR 51 (SL), by Sikacorp., Lyndhurst, NJ, or equal.

2.04 CONCRETE MIX

- A. Mix and deliver concrete in accordance with ACI 318 Sections 26.4 and 26.5. Deliver concrete in transit mixers only. Discharge loads in less than 1-1/2 hours after water is first added.
 - 1. Design Mix: Conform to Section ACI 318 Chapter 26 for Proportioning on the basis of field experience or trial mixtures method.
 - 2. Conform to ACI 318, Section 26.4 for Selection of concrete proportions method. Selection of concrete proportions and ingredients for design mix by a DSA [OSHPD] approved Testing Laboratory and certified by a registered civil engineer licensed in California.
 - 3. Do not exceed 0.45 water-cement ratio by weight for floor slabs and for other concrete.
- B. Select proportions by volume for concrete in accordance with the approved design mix.
 - 1. Required Strength: As noted on the structural drawings and below.
 - 2. Grout Mix: 1:3:2 Portland Cement, to sand, to pea gravel, minimum 2000 psi at 28 days.

- C. Provide concrete to the following criteria:

Element	Min 28 day Strength PSI	Max Slump	Max Size Aggregate Type
Grade Beams and Foundations	3,500	4 inch	3/4 inch Normal wt. Concrete
Flr. Slabs on grade	4,000	4 inch	3/4 inch Normal wt. Concrete
Other	3,000	4 inch	3/4 inch Normal wt. Concrete

- D. Miscellaneous Sitework Concrete: Specified in Section 32 13 13, Sitework Concrete.
- E. Do not use admixtures containing chlorides.

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2.05 GRANULAR FILL

- A. Crushed Aggregate Base (capillary break): 3/4 inch maximum grading, crushed rock and rock dust conforming to requirements of Section 200-2.2, SSPWC, with 3/8 inch sieve requirement waived, or Class 2 Aggregate Base as defined in Section 26, CSS.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify site conditions.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely and will not cause hardship in placing concrete.

3.02 PREPARATION

- A. Prepare previously placed concrete by cleaning with sandblasting to remove laitance and expose clean aggregate.
- B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- C. When approved by the Architect, clean previously placed concrete with steel brush and apply bonding agent in accordance with manufacturer's instructions.
- D. Under Interior Slabs on Grade: Install 4 inches thick crushed aggregate base per Section 200-2.2, SSPWC or Class 2 CCS as capillary break. Over aggregate base place 15-mil vapor retarder in largest practical sections. Seal all 6-inch lapped seams, penetrations and foundation perimeters using manufacturer-approved tape only and install per manufacturer instructions. Install pipe boots at pipe penetrations. [Install rigid insulation]. Install reinforcement and concrete as scheduled.
 - 1. Tapes, mastics, sealants, and other products used with vapor retarder shall be from same manufacturer as, and certified compatible with, vapor retarder.
- E. Install steel reinforcing per Section 03 20 00. Place concrete slab as scheduled.

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3.03 PLACING CONCRETE

- A. Place concrete in accordance with ACI 318, Section 26.5.2. Remove loose dirt from excavations.
- B. Notify Architect minimum 24 hours prior to commencement of operations. All excavations, forms and reinforcing shall be inspected and approved by the Architect prior to placement.
- C. Ensure reinforcement, inserts, embedded parts, formed joint fillers, joint devices and accessories are not disturbed during concrete placement.
- D. Install joint fillers, primer and sealant in accordance with manufacturer's instructions.
- E. When detailed on the drawings, separate slabs on grade from vertical surfaces with 1/2 inch thick joint filler.
- F. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface using two-component polyurethane sealant as specified in Section 07 92 00.
- G. Install joint devices in accordance with manufacturer's instructions as detailed.
- H. Install construction joint device in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- I. Maintain joint device in correct position to allow joint cover flush with finish.
- J. Install joint covers in longest practical length.
- K. Place concrete continuously between predetermined expansion, control and construction joints.
 - 1. Install expansion joints at vertical concrete walls at 24 feet on center unless noted otherwise on drawings.
- L. Do not interrupt successive placement; do not permit cold joints to occur.
- M. Avoid segregation of materials. Perform vibrating so as to produce a dense, smooth application free of rock pockets and voids. Do not use vibrators to move concrete horizontally.
- N. Provide special mix prepared by the Testing Laboratory and approved by the Architect utilizing smaller aggregates in areas of reinforcing congestion to prevent the formation of rock pockets.
- O. The unconfined vertical drop of concrete shall not be greater than 5 feet. Do not allow concrete to fall free from any height that will cause materials to segregate. Maximum

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height of free fall permitted in any case: 5 feet. Utilize trunks or additional chutes where doubt occurs. Conform to requirements of ACI 318, Section 26.5.2.

- P. Construction Joints: Wash surface of each joint shortly after pouring to expose clean, sound aggregate. Sandblast surface to remove laitance remaining or loose aggregate as approved by the Architect. Conform to ACI 318, Section 26.5.6. Apply bonding agent in accordance with manufacturer's instructions. Locate joints within the middle third of spans of slabs, beams and girders. Coincide construction joints with contraction, isolation, or expansion joints when possible. Locate where they least affect the structural integrity of the element under consideration and are compatible with building's appearance.
- Q. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/8 inch in 10 ft. Slope floors for drains.
- R. Contraction Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch, place joints at column lines and at 12 ft. o.c. each way, maximum. Remove groover tool marks on exposed concrete surfaces. Contractor's option: Saw cut joints, early-entry dry-cut, per ACI 302.1R.
- S. Saw cut slabs when indicated on drawings or as approved by Architect at 12 ft. on center, within 4-12 hours after placing concrete. Saw cut joints with power saws equipped with shatterproof abrasive re diamond-rimmed blades, cut 1/8 " wide joint into concrete when cutting action will not tear, abrade, or otherwise damage surface. Cut no deeper than 1/4 depth of slab thickness. Fill cuts with non-hardening epoxy. Completely fill cut to surface of slab. Sawing and timing: "early-entry dry-cut ", per ACI 302.1R. Section 8.3.12.
- T. Isolation Joints: preformed joint filler depth of slab, fill top 1/2 inch with elastomeric sealant per Section 07 92 00. Locations: at columns, footings, and as noted on drawings.
- U. Steel Pan Stairs: Install safety nosings at each tread, all steel pan stairs.
- V. Surface irregularities, ACI 347R Class A, gradual or abrupt irregularities of 1/8 inch for exposed to view concrete. Class B, 1/4 inch for plaster cement finish.

3.04 FINISH AT ALL EXPOSED SURFACES

- A. Refer to Section 03 20 00, Concrete Formwork.

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3.05 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.
- B. Maintain concrete with minimal moisture loss at above 50 degrees F temperature for period necessary for hydration of cement and hardening of concrete. Dusting with dry cement to absorb excess water is prohibited.
- C. Cure floor surfaces only as specified herein and in accordance with Section 1905A.11, California Building Code. Liquid membrane curing compound method not permitted for interior cast-in-place concrete slabs.
- D. Moisture Retaining Coverings: spread polyethylene film over floor slab areas, lapping edges and sides, minimum 6 inches and sealing with pressure sensitive tape; cover with plywood or otherwise protect film from damage; maintain in place for minimum of seven (7) day unless noted otherwise on the drawings. Do not permit traffic over floor slabs during the curing period.
- E. Vertical Surfaces: Spray water over surfaces and maintain wet for 10 days.
- F. Quality Control: Proper curing of concrete surfaces shall be the responsibility of the Contractor under this section.

3.06 FIELD QUALITY CONTROL

- A. Provide free access to Work and cooperate with Testing Laboratory.
- B. Measure floor and slab flatness and levelness according to ASTM E1155 within 72 hours of finishing.
- C. Proposed mix design of each class of concrete shall conform to ACI 318, Section 26.4, California Building Code and shall be approved by the Architect prior to commencement of work.

3.07 PATCHING

- A. Architect will inspect concrete surfaces and determine imperfections, if any.
- B. Patch imperfections as approved and in accordance with ACI 301.
 - 1. Clean all exposed concrete surfaces and all adjoining work stained by leakage of concrete. Remove all fins, butts and projections by grinding. Patch voids, rock pockets, holes, cracks and similar imperfections by chipping loose concrete and exposing clean, sound aggregate.
 - 2. Fill cone form tie recesses with portland cement mortar flush to finish surface.

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3.08 PROTECTION FOR EXPOSED CONCRETE TO BE TREATED OR SEALED

- A. Protection. There is no known satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Protect the concrete floor until ready for treatment/sealing.
1. All hydraulic powered equipment must be diapered to avoid staining of the concrete.
 2. No trade shall park vehicles on interior slabs. If necessary to complete their scope of work, drop cloths shall be placed under vehicles at all times.
 3. No pipe cutting machine shall be used on interior slabs.
 4. Steel shall not be placed on interior slabs to avoid rust staining.
 5. All equipment must be equipped with non-marking tires.
- B. Flooring shall be protected as follows: Use "Ram Board Plus ", Burbank, CA. "Builder Board with Liquid Shield " by Surface Shields, Oakland Park, ILL, or equal.
1. Ram Board: Heavy Duty temporary floor protection membrane, 38 " wide x 100' rolls, 46 mils thick.
 2. Protect entire floor where area anticipated to be affected. Submit layout of protected area to Architect for approval.
 3. Loose lay protection material over floor area; tape all seams; do not tape or otherwise attach to floor; follow manufacture's installation requirements.
 4. Take other precautions as necessary to prevent damage in addition to requirements above, refer to Section 03 35 00 [03 35 43]. Submit to Architect for approval.

3.09 DEFECTIVE CONCRETE

- A. Defective Concrete: Remove concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Architect.
- C. Do not patch, fill, touch-up, repair or replace exposed concrete except upon express approval of Architect for each individual area.

3.10 MOISTURE TEST FOR CONCRETE FLOORS

- A. It shall be the Contractor's responsibility to provide a concrete floor slab meeting the maximum moisture vapor emissions here-in specified and the Contractor shall exercise care in all aspects of mixing, placing, and curing the concrete floor slabs so that a minimum of mitigation treatment will be required.

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- B. Prior to ordering adhesives applied floor covering materials or coatings, conduct Calcium-Chloride Test Method in accordance with ASTM F1869 and ASTM F2170 to

verify that concrete floor slabs are dry with maximum moisture vapor emissions of 3 pounds per 1,000 square feet in 24 hours and that slabs exhibit negative alkalinity, carbonation or dusting. Apply the moisture test in four (4) different areas of each floor location, with at least one test for each 1,000 square feet of floor area.

- C. Prior to ordering adhesive-applied floor covering materials or coatings, conduct Relative Humidity Test Method in accordance with ASTM F1869 and ASTM F2170 to verify relative humidity and surface pH of concrete floor slabs, the method
1. Requires drilling holes at diameter not to exceed outside diameter of probe by more than 0.04 inch to depth equal to 40 percent of slab's thickness (elevated structural slab shall be tested at depth equal to 20 percent of slab thickness).
 2. Place probe to full depth of test hole, place cap over probe.
 3. Permit test site to acclimate, or equilibrate, for 72 hours prior to taking relative humidity readings.
 4. Remove cap and press button on the probe to obtain reading.
 5. Relative humidity readings for substrates receiving non-permeable flooring are 75% or lower.
 6. Testing shall require 3 tests in first 1,000 square feet, with one additional test per each additional 1,000 square feet of concrete slab surface.
- D. Alkalinity Testing: Concrete floors shall be tested for alkalinity prior to the installation of adhesive-applied floor covering materials or coating. Levels of pH shall not exceed the written recommendations of the flooring covering manufacturer or the adhesive manufacturer, or both.
- E. The test area should be at the same temperature and humidity expected during normal use, minimum testing conditions shall be 75+ 10 degrees F. and 50+ 10% relative humidity. Maintain these conditions 48 hours prior to, and during testing.
- F. Install Concrete Slab Vapor Emission Treatment as specified in Section 09 05 61. Submit results to Architect of testing.

END OF SECTION

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Miscellaneous metal items indicated and specified, or otherwise necessary for completion of the work. Work of this section includes, but is not limited to, the following:
 - 1. Ferrous and non-ferrous metalwork detailed on the drawings as a component part of other assemblies, but not specified elsewhere.
 - 2. Miscellaneous steel framing and supports including:
 - a. Overhead grilles.
 - b. Applications where framing and supports are not specified in other Sections.

1.02 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Slotted channel framing.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 COORDINATION

- A. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.04 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

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PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal fabrications, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Structural Performance of Slotted Channel Framing: Slotted Channel Framing shall withstand the effects of loads and stresses applied by equipment being supported.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B or structural steel, Grade 33; 0.0528-inch minimum thickness; unfinished.

2.03 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

2.04 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

HMC Architects
3186071000

METAL FABRICATIONS
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- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Prime miscellaneous framing and supports where indicated.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

3.02 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead grilles securely to, and rigidly brace from, building structure.

END OF SECTION

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SECTION 05 73 00 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Stainless steel decorative railings with aluminum infill.

1.02 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.03 ACTION SUBMITTALS

- A. Product Data:
1. Manufacturer's product lines of decorative metal railings assembled from standard components.
 2. Laser cut metal infill panels.
 3. Fasteners.
 4. Nonshrink, nonmetallic grout.
 5. Metal finishes.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.
- D. Samples for Verification: For each type of exposed finish required.
1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters
- E. Design Data Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

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1.05 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Decorative Metal Railings:
1. Basis-of-Design Product: Subject to compliance with requirements, provide VIVA Railings, LLC; CUBE Stainless Steel Railings, or comparable product by one of the following:
 - a. C.R. Laurence Co., Inc.
 - b. CraneVeyor Corp.
 - c. Hollaender Mfg. Co.
 - d. Livers Bronze Co.
 - e. Wylie Systems.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics.
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.

2.02 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
 2. Stainless Steel: 60 percent of minimum yield strength.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.

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- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.03 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.04 ALUMINUM DECORATIVE RAILINGS

- A. Source Limitations: Obtain aluminum decorative railing components from single source from single manufacturer.
- B. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- C. Plate and Sheet: ASTM B209, Alloy 6061-T6.

2.05 STAINLESS STEEL

- A. Tubing: ASTM A554, Grade MT 304.
- B. Castings: ASTM A743/A743M, Grade CF 8 or CF 20.
- C. Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304 .
- D. Flat Bar: ASTM A666, Type 304.
- E. Bars and Shapes: ASTM A276, Type 304.

2.06 FASTENERS

- A. Fastener Materials:
 - 1. Aluminum Railing Components: Type 304 stainless steel fasteners.
 - 2. Stainless Steel Railing Components: Type 304 stainless steel fasteners.
 - 3. Dissimilar Metal Railing Components: Type 304 stainless steel fasteners.
 - 4. Finish exposed fasteners to match appearance, including color and texture, of railings.

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2.07 MISCELLANEOUS MATERIALS

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.08 FABRICATION

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- F. Connections: Fabricate railings with mechanical connections unless otherwise indicated.
- G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings.
 - 1. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 2. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- H. Form changes in direction as follows:
 - 1. As detailed.
- I. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

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- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- L. Laser Cut Infill Panels: Fabricate infill panels from laser cut panels made from aluminum.
 - 1. Basis-of-Design Product: VIVA Railings, LLC; CUBE Laser Cut Panel.
 - 2. Orient perforated metal with pattern as indicated on Drawings.

2.09 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.10 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Stainless Steel Finishes:
 - 1. Color Electro-Plated Metal: Vertical and stand-off components.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide VIVA Railings, LLC; ECM Finish System or comparable product.
 - b. Color: As selected by Architect from manufacturer's full range.

2.11 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

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PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.02 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 - 4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

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3.04 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post.

3.05 REPAIR

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

3.06 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

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SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Rough carpentry.

1.02 REFERENCE STANDARDS

- A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.
- B. ASTM International:
 - 1. ASTM D 4601 - Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
 - 2. ASTM E 84 - Surface Burning Characteristics of Building Materials.
- C. CBC - California Building Code, 2022
- D. California Green Building Standards Code, CALGreen - 2022.
- E. DOC PS 1 - Department of Commerce Product Standard, U. S. Product Standard for Construction and Industrial Plywood.
- F. DOC PS 20 - Department of Commerce Product Standard, American Softwood Lumber Standards.
- G. DOC PS 2 - Department of Commerce Product Standard, U. S. Product Standard for Construction, Performance Standard for Wood-Based Structural-Use Panels.
- H. ANSI A135.4 - Basic Hardboard.
- I. WWPA - Western Lumber Grading Rules 88, Latest Edition, by Western Wood Products Association.
- J. HPVA HP-1 - American National Standard Institute, Hardwood Plywood and Veneer Association.
- K. APA - The Engineered Wood Association. The Construction Guide.
- L. AWWA C1, C2, C3, C9, C27 - American Wood Preservers Association - Manual of Recommended Practice.

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- M. AWPA C20 - American Wood Preservers Association Standards, Structural Lumber - Fire-Retardant Treatment by Pressure Process.
- N. WCLIB - West Coast Lumber Inspection Bureau Standard Grading Rules No. 17.
- O. Title 8 - California Code of Regulations, Construction Safety Orders.
- P. ICC - ES - International Code Council Evaluation Service, Inc. Legacy Reports.
- Q. RIS - Redwood Inspection Service, Standard Specifications for Grades of California Redwood Lumber.
- R. Local AQMD - Local Air Quality Management District Regulations.

1.03 SUBMITTALS

- A. Product Data: For the following:
 - 1. Product Data and current ICC Legacy Reports.
- B. Material Certificates.
- C. CALGreen Submittals:
 - 1. Product Data Sheets and Declaration Statements showing compliance with CALGreen Code per 1.04.A.

1.04 QUALITY ASSURANCE

- A. California Green Building Standards Code, CALGreen - 2022.
 - 1. Adhesives, sealants, primers, and caulks shall comply with air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, per CALGreen Tables 5.504.4.1 and 5.504.4.2.
 - 2. Paints and Coatings shall comply with VOC limits in Table 1 of the ARB, per CALGreen Table 5.504.4.3.
 - 3. Composite wood products (plywood, particle board, medium density fiberboard) shall comply with Formaldehyde limits per CALGreen Table 5.504.4.5.
- B. Rough Carpentry Lumber: Visible grade stamp on all products required.
- C. Grade Stamp: Association under whose rules it was graded, or official grade mark of other recognized grading agencies using grading rules, equivalent to WWPA or WCLIB.
- D. Association performing grading and grade marking of lumber shall be approved by Architect and Division of the State Architect.

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- E. Nailing guns and nail operators shall be approved in accordance with Title 8 Construction Safety Orders.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver rough carpentry items until site conditions are adequate to receive the Work. Protect items from weather while in transit.
- B. Store lumber and plywood at the site under cover or otherwise protected against exposure to weather, raise above ground and out of contact with damp or wet surfaces. Stack lumber and plywood and provide for air circulation within and around stacks and under temporary covers. For pressure treated lumber and plywood, provide spacers between courses to permit air circulation.
- C. Install bracing as required. Make proper provision to take care of stresses resulting from construction loads, whenever piles materials, erection equipment or other loads are carried by frame during its erection.

1.06 FIELD CONDITIONS

- A. Cooperate with other trades in coordinating their Work with the Work of this Section. Provide wood grounds, blocking and nailer where indicated or as required for Work of other trades.

PART 2 - PRODUCTS

2.01 ROUGH CARPENTRY MATERIALS

- A. Lumber: Graded in accordance with WWPA or WCLIB; maximum moisture content of 19 percent at time of installation. Provide Douglas Fir Larch for structural and framing lumber, surfaced four sides to standards of the grading association unless otherwise indicated on Drawings, use the following grades:
 - 1. Joists, rafters, beams, lintels, horizontal framing, posts, studs and vertical framing: No. 1 unless otherwise indicated or noted on drawings.
 - 2. Non-bearing studs and plates, non-structural furring, concealed blocking, stripping and miscellaneous nailers and backing: No. 2 unless noted otherwise in the structural drawings.
 - 3. Structural Drawings take precedence for lumber grades.
 - 4. All lumber in contact with concrete shall be pressure treated.

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- B. Plywood: CBC Section 2303.3 and 2304.6, Douglas Fir 1 Group Species, PS 1, APA Structural I Rated Sheathing. Bond Classification; Exposure 1 plywood grade. Thickness as indicated, span rating sized for spacing.
 - 1. For painted finish for interior and exterior: APA Sanded Plywood Panels, Panel Grade A-C, Group 1, Exterior plywood grade, sanded face, touch sanded back side.
 - 2. Exposure 1 plywood grade: "CDX", Structural I, C-D.
- C. Roof Plywood Decking: requiring FM 1-90 Wind and Fire Classification, minimum 1/2" thick. CBC Section 2304.8, Douglas Fir 1 Group Species, PS 1, APA Structural I Rated Sheathing. Bond Classification: Exposure 1, B-C Veneer Grade, sanded 1 side. Thickness as indicated, span rating sized for spacing.
- D. Board Roof Decking: 2 x 6 Douglass Fir, kiln dry, #1 Grade Lumber, Tongue and Groove, surfaced one side.
- E. Preservative (Pressure) Treated Lumber: Section 2303.1.9 Conform to AWWPA Manual of Recommended Practice, kiln dry after treatment. Use preservative complying with AWWPA C2 lumber and C9 plywood, latest edition. Products NOT containing arsenic or chromium. Conform to AQMD, Local Regulations.
 - 1. Douglas Fir Larch, used as required by Section 2303.1.9.1, CBC, shall conform to the following:
 - a. Lumber shall be WWPA or WCLIB grade stamped.
 - b. Lumber shall be No. 1 grade or better unless indicated otherwise on Drawings.
- F. Plywood Backing Panels - Backboards:
 - 1. Telephone and Electrical Equipment backboards, fixed equipment, cabinets, grab bars, door stops and plates: DOC PS 1, Exposure 1, APA A-C, sanded, Veneer Grade, fire-retardant treated, in thickness indicated or, if not indicated, not less than 5/8-inch nominal thickness. Installed "A" side out for paint finish.

2.02 ACCESSORIES

- A. Nails, Spikes and Staples: Section 2304.10 CBC, Galvanized for exterior applications, high humidity locations and treated wood; plain finish for other interior locations; size and type to suit application. Comply with Table 2304.10.1. Use common nails only.
- B. Bolts, Nuts, Washers, Lags, Pins and Screws: Section 2304.10 CBC, sized to suit application, galvanized for exterior locations, high humidity locations and treated wood, plain finish for other interior locations. Full diameter body bolts only per ASME B18.2.1(.2) or B18.2.6 for structural applications.
- C. Expansion type or powder actuated type for anchorage to solid concrete.
 - 1. Kwik Bolt TZ2 (KB-TZ2) Concrete Anchor, 3/8- to 3/4-inch diameter, ICC ESR-4266, by Hilti Inc.

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- D. Stock Framing Connectors: Types indicated on Drawings, galvanized, with nails fully driven in all holes in each face of connector. Conform to the following.
 - 1. Manufacturers: Simpson Strong Tie Co., Inc., San Leandro, CA.
- E. Non-Stock Framing Connectors: Conform to details.
- F. Nonshrink Grout: ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5,000 psi in 24 hours and 8,000 psi in 7 days; of consistency for application and a 30 minute working time. Acceptable Manufacturers: Dayton Superior, Miamisburg, OH; Sonneborn, Shakopee, MN; Novex Systems International, Clifton NJ, or equal.
- G. Adhesives: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
 - 1. Adhesives shall comply with Local AQMD and California VOC Regulations.

PART 3 - EXECUTION

3.01 LAYOUT MARKINGS

- A. Layout markings shall not be made with xylene-based inks, paint, or dyes, or with other solvent-based products that may bleed through finishes.

3.02 FRAMING, FURRING AND STRIPPING

- A. Erect wood framing, furring, stripping and nailing members true to lines and levels. Do not deviate from true alignment more than 1/4 inch in 10 feet, non-cumulative.
- B. Construct members of continuous pieces of longest possible lengths.

3.03 2 X ROOF DECKING

- A. Place floor decking] with end joints staggered. Secure boards over firm bearing. Maintain tight spacing between joints of boards. Place diagonal to framing members of rafters or joists.
- B. Maintain surface flatness of maximum 1/8 inch in 10 ft.
- C. Fit edges tight and secure with nails.

3.04 PLYWOOD SHEATHING

- A. Thickness as indicated on the Drawings, minimum thickness 1/2 inch.

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- B. Boundary Nailing: Not less than 3/8 inch from edge, spaced not more than 6 inches on center, unless noted otherwise on Drawings.
- C. Blocking: Panel edges shall bear on framing members or solid blocking.
- D. Minimum Size Vertical Panel: 16 inches wide.
- E. Minimum Size Horizontal Panel: 24 inches wide.
- F. Oriented Strand Board not permitted for shear panels unless indicated on structural drawings.

3.05 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Nail to wood framing.
 - b. Space panels 1/8 inch apart at edges and ends.

3.06 HORIZONTAL FRAMING

- A. Bearing: 1-1/2-inch minimum on wood or metal, 3 inches on masonry. Lay framing members with crown up. Members with knots at bottom not permitted.
- B. Lateral Support: Use solid blocking, cross bridging or other approved means.
- C. Lap joists a minimum of 3 inches when framed from opposite sides of a beam. Do not run joists continuous beyond one span unless indicated otherwise on Drawings.
- D. Openings: Double joists required for trimmer and headers for openings 4 ft. or larger unless indicated otherwise on Drawings.
- E. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

END OF SECTION

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SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rooftop equipment bases and support curbs.
2. Wood blocking and nailers.
3. Plywood backing panels.

B. Related Sections:

1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
2. Section 06 10 00 "Rough Carpentry" for dimension lumber framing.

1.02 INFORMATIONAL SUBMITTALS

A. Sustainable Design Submittals:

1. Documentation for composite wood products, indicating compliance with emissions testing or certification.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:

1. Composite Wood Products:
 - a. Formaldehyde emissions testing or certification.

2.02 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

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2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.03 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood floor plates that are installed over concrete slabs-on-grade.

2.04 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.

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2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:

1. Plywood backing panels.

2.05 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.06 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.07 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

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PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- D. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- F. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

END OF SECTION

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MISCELLANEOUS ROUGH
CARPENTRY
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SECTION 06 16 00 - SHEATHING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Exterior wall, soffit and parapet sheathing.

1.02 RELATED REQUIREMENTS

- A. Section 01 81 13, Sustainable Design Requirements, for CAL-Green general requirements and procedures.
- B. Section 06 10 00, Rough Carpentry, for structural plywood sheathing.
- C. Pertinent Sections specifying wall cladding and finishes over sheathing.

1.03 REFERENCES AND STANDARDS

- A. California Building Code (CBC), edition as noted on Drawings.
- B. California Green Building Standards Code (CAL Green).
- C. ASTM International:
1. B 117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 2. C 518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 3. C 834, Standard Specification for Latex Sealants.
 4. C 954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 5. C 1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 6. C1007, Standard Specification for installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
 7. C 1177, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 8. C 1280, Standard Specification for Application of Gypsum Sheathing.
 9. D 3273, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 10. D 6329, Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers.

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11. E 72, Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
12. E 96 Standard Test Methods for Water Vapor Transmission of Materials.
13. E 119, Standard Test Methods for Fire Tests of Building Construction and Materials.
14. E 136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 deg C.

D. Engineered Wood Association (APA):

1. APA Document PS-1, Structural Plywood Voluntary Product Standard.
2. APA Document PS-2, Performance Standard for Wood-Based Structural Use Panels.
3. APA Form No. E30, Engineered Wood Construction Guide.
4. APA Q370G, Installation of Stucco Exterior Finish Over Wood Structural Panels.

E. Gypsum Association (GA):

1. GA-253, Application of Gypsum Sheathing.
2. GA-600, Gypsum Fire Resistance Design Manual.

F. International Code Council (ICC):

1. ICC-ES AC70, Power-driven Fasteners Driven into Concrete, Steel and Masonry Elements.

G. Underwriters Laboratories, Inc. (UL):

1. UL Fire-Resistance Directory.

H. Georgia Pacific (GP):

1. DensGlass Technical Guide, 2017, Lit. Item #622599.

1.04 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.
3. Sustainable Design Submittals shall comply with the additional requirement of Section 01 81 13, Sustainable Design Requirements.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, demonstrate compliance with specified attributes.

1.06 INFORMATIONAL SUBMITTALS

- A. Research / Evaluation Reports: Provide ICC-ES report showing compliance with building code in effect for Project for the following.
1. Fiberglass-mat faced gypsum sheathing.

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- B. Sustainable Design:
 - 1. General:
 - a. Submit information necessary to establish and document compliance with the California Green Building Standards Code.
 - b. Sustainable design submittals are in addition to other submittals.
- C. Sample of manufacturer's warranty.

1.07 CLOSEOUT SUBMITTALS

- A. Warranty/Guarantee: Submit executed warranty and Subcontractor's guarantee.

1.08 QUALITY ASSURANCE

- A. Use only new materials and products, unless existing materials or products are specifically shown otherwise on the Drawings to be salvaged and re-used.
- B. Single-Source Responsibility: Use materials and products of one manufacturer whenever possible.
- C. Materials, components, assemblies, workmanship and installation are to be observed by the Project Inspector. Work not so inspected is subject to uncovering and replacement.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in original package or bundles bearing brand name and labeled with identification of manufacturer or supplier.
- B. Stack panels flat with spacers between each bundle to provide air circulation.
 - 1. Protect sheathing from weather by covering with waterproof sheeting, securely anchored.
 - 2. Support panels to prevent sagging.
- C. Handle gypsum sheathing to prevent damage to edges, ends, and surfaces.

1.10 WARRANTY

- A. Manufacturer: In addition to the Contractor's and Subcontractor's Guarantee, furnish Owner with manufacturer's fully executed written warranty for the following:
 - 1. Fiberglass-Mat Faced Gypsum Sheathing: Manufacturer's limited warranty against manufacturing defects.
 - a. Warranty Periods:
 - 1) Five (5) years unless otherwise noted.
 - 2) Twelve (12) years when used as a substrate in architecturally specified EIFS assembly.

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PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer: Georgia-Pacific Gypsum LLC (GP); www.gp.com.
 - 1. Substitutions: Per Division 01.

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL Fire-Resistance Directory or GA-600 Fire Resistance Design Manual.

2.03 WALL, SOFFIT AND PARAPET SHEATHING – GYPSUM

- A. Exterior Gypsum Sheathing: DensGlass® Sheathing manufactured by GP.
 - 1. Physical Properties:
 - a. Fiberglass-Mat Faced Gypsum Sheathing: Gypsum sheathing; with water-resistant-treated core and fiberglass mat with primer coating bonded to core's face, back, and long edges.
 - b. Core Thickness: 1/2 inch.
 - c. Panel Size: 48 inches by 96 inches, 108 inches or 120 inches.
 - 1) Use maximum length as allowable by wall framing.
 - d. Combustibility: Noncombustible per ASTM E 136.
 - e. Fire Resistant: Type X per ASTM C 1177, ASTM E 136 and ASTM E 119.
 - f. Weight: 1.9 lb/sq. ft.
 - g. Edges: Square.
 - h. Surfacing: Fiberglass mat on face, back, and long edges.
 - i. Racking Strength: Not less than 540 pounds per square foot, dry per ASTM E 72.
 - j. Flexural Strength: 80 lbf, parallel per ASTM C 1177.
 - k. Humidified Deflection: Not more than 1/4 inch per ASTM C 1177.
 - l. Permeance: Not less than 23 perms per ASTM E 96.
 - m. R-Value: 0.56 per ASTM C 518.
 - n. Mold Resistance: Score of 10 when tested in accordance with ASTM D 3273.
 - o. Microbial Resistance: UL Environmental GREENGUARD, 3-week protocol per ASTM D 6329, will not support microbial growth.

2.04 WALL, SOFFIT AND PARAPET SHEATHING – PLYWOOD

- A. Nonstructural Plywood Sheathing APA Rating: Exterior C-D with exterior adhesive bond classification per APA Document PS-1.
 - 1. Provide T&G (tongue and groove) panels where indicated.

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B. Physical Properties:

1. Nominal Thickness: As indicated on Drawings.
2. Panel Size: 48 inches by 96 inches or 120 inches.
 - a. Use maximum length allowable by wall framing.

2.05 FASTENERS

- A. Screws for Fastening Sheathing to Wood Framing: Comply with ASTM C 1002.

2.06 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing Board: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing, and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
- B. Sheathing Tape for Glass-Mat Gypsum Sheathing Board: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads / inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board.
- C. Refer to Section 07 92 00, Joint Sealants, for penetration sealant.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine conditions with installer present and verify that field conditions are acceptable and are ready to receive work.
- B. Framing members shall not vary more than 1/8" from the plane of the faces of adjacent framing.
- C. Correct conditions detrimental to the proper and timely performance of this work before proceeding with installation.
- D. Commencement of work indicates acceptance of substrates.

3.02 INSTALLATION – GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
1. Arrange joints so that pieces do not span between fewer than three support members.

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- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Coordinate wall, soffit and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- D. Do not bridge building expansion joints with panels.
- E. Cut and space edges of panels to match spacing of structural support elements.
- F. Locate sheathing panel edges 4 inches minimum away from reentrant wall opening corners, such as for windows, doors, louvers, etc.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.
- H. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Requirements of referenced building code.
 - 2. ICC-ES evaluation report for fastener.

3.03 GYPSUM SHEATHING INSTALLATION

- A. General: Install in accordance with GA-253, ASTM C 1280, and the manufacturer's written instructions.
- B. Fasten gypsum sheathing to framing with screws.
- C. Install boards with a 3/8 inch gap where non-load-bearing construction abuts structural elements.
- D. Install boards with a 1/4 inch gap where they abut masonry, concrete or similar materials that might retain moisture, to prevent wicking.
- E. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.
- F. Vertical or Horizontal Installation: Abut ends of boards over centers of stud. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
 - 2. At horizontal installations, stagger end joints of adjacent boards not less than one stud spacing.

3.04 PLYWOOD SHEATHING INSTALLATION

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- A. Fasten nonstructural plywood sheathing to framing with screws.
- B. Space panels 1/8 inch apart at edges and ends.
- C. Abut ends of boards over centers of stud. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners in accordance with APA Form No. E30.
 - 2. At horizontal installations, install sheathing with grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing.

3.05 SHEATHING JOINT TREATMENT

- A. Treat sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Treat all gaps greater than 1/4 inch with sealants.

3.06 DEFECTIVE WORK

- A. Repair damaged and defective work and eliminate functional defects. Where repair is not possible replace work.

END OF SECTION

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SECTION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad cabinets.
2. Cabinet hardware and accessories.
3. Shop finishing.

B. Related Sections:

1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
2. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.

1.02 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

B. Coordinate locations where appliances are to be installed and coordinate dimensions to ensure the correct size openings are provided.

1. Shop drawings shall clearly indicate locations and opening dimensions.
2. Where appliances are not in contract, shop drawings shall request confirmation of critical dimensions.
3. Adjustments that need to be made to the casework due to appliances not fitting correctly are to be done at no additional cost to the Project.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For architectural cabinets.

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in architectural cabinets.
 - a. Show locations and opening dimensions for OFCI appliances.

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5. Apply WI Certified Compliance Program label to Shop Drawings. First page of shop drawings and each elevation shall bear an individually serial-numbered WI "Certified Compliance Label."

C. Samples for Verification: For the following:

1. Lumber and Panel Products with Shop-Applied Opaque Finish: 5 inches wide by 12 inches long for lumber and 8 by 10 inches for panels, for each finish system and color.
 - a. Finish one-half of exposed surface.
2. Corner Pieces:
 - a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.
3. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.04 INFORMATIONAL SUBMITTALS

A. Sustainable Design Submittals:

1. Documentation for composite wood products, indicating compliance with emissions testing or certification.

B. Qualification Data: For manufacturer and Installer.

1.05 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

1.06 QUALITY ASSURANCE

A. Quality Standard: Unless otherwise indicated, comply with WI's North American Architectural Woodwork Standards (NAAWS) for grades indicated for construction, finishes, installation, and other requirements.

1. Provide WI-Certified Monitored compliance labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.
2. Where the Contract Documents contain requirements that are more stringent than the referenced quality standard, comply with requirements of the Contract Documents in addition to those of the referenced quality standard.

B. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in WI's Monitored Compliance Program.

C. Installer Qualifications: Licensed participant in WI's Monitored Compliance Program.

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1. All casework and the installation thereof for this project shall be directly monitored for compliance to the Contract by the Woodwork Institute under the scope of their Monitored Compliance Program (MCP).
 - a. Inspections are to be performed at the beginning of fabrication, at the time of delivery to the job, at the beginning of installation, at completion of installation.
 - b. Further information on the WI Monitored Compliance Program's Policies and Procedures are available directly from the Woodwork Institute, 916-372-9943.
 - c. The WI MCP Registration Number shall be referenced in all communication.
 2. Fees charged by the Woodwork Institute for their monitored compliance service are the responsibility of the Contractor and shall be included in the Contract sum.
 3. Casework and/or installation determined to be non-compliant by WI and not corrected will be rejected.
 4. Issuance of the WI Monitored Compliance Certificate is a prerequisite of the Owner's final acceptance.
- D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Build mockups of of one base cabinet and one wall hung cabinet 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..
 - a. The base cabinet is to have at least one drawer and be of the same material to be provided for the project.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.07 DELIVERY, STORAGE, AND HANDLING
- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- 1.08 FIELD CONDITIONS
- A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
 - B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

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1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 1. Composite Wood Products:
 - a. Formaldehyde emissions testing or certification.

2.02 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Architectural Woodwork Standards Grade: Custom.
- B. Type of Construction: Style A Frameless.
- C. Door and Drawer-Front Style: As indicated on drawings overlay.
 1. Reveal Dimension: As indicated on drawings.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
 1. Basis-of-Design Products: As indicated on Drawings.
- E. Laminate Cladding for Exposed Surfaces:
 1. Horizontal Surfaces: Grade HGS.
 2. Vertical Surfaces: Grade HGS.
 3. Edges: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
- F. Materials for Semiexposed Surfaces:
 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
 2. Drawer Sides and Backs: 1/2 inch thick MDF.
 3. Drawer Bottoms: 1/2 inch thick MDF.
- G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

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- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued dovetail joints.
- I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated on drawings.

2.03 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
 - 2. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard (MDF): Certified wood, ANSI A208.2, Grade 155.
 - a. Product: Roseburg; Medite II.
 - 2. Softwood Plywood: DOC PS 1.

2.04 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 "Door Hardware."
- B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch- thick metal, and as follows:
 - 1. Semiconcealed Hinges for Overlay Doors: ANSI/BHMA A156.9, B01521.
 - 2. Product: RPC; Model 374.
- C. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.
 - 1. Product: Epco 'U-shaped' wire pulls.
- D. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.
 - 1. Product: Ives; Model 326, BHMA 673.
- E. Elbow Catches: Ives; #2 Elbow Catch.
- F. Shelf Rests: ANSI/BHMA A156.9, B04013; metal with shelf hold-down clip.
 - 1. Product: Hettich; Sekura 1.1.

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- G. Door Locks: ANSI/BHMA A156.11, E07121.
 - 1. Product: National; C8178, 7/8 inch, 26D.
- H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
 - 1. Product: 3M Bumpon Protective Products; Hemispherical, quiet clear type, 55 Shore A hardness.
- I. Grommets for Cable Passage through Countertops: 3-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Haefele; Cable Set, Two-Piece, Round.
 - 2. Color: As selected by Architect.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA finish number indicated.
 - 1. All exposed hardware finishes to be Satin Aluminum.
- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.05 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.06 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated. Ease edges and corners to 1/16-inch radius unless otherwise indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
 - 2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

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- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- D. Fabrication of Cabinet Bodies:
1. Fabricate, assemble and finish each cabinet as complete, self-supporting unit.
 - a. Unless otherwise shown, counter height and tall storage units shall be 24 inches minimum overall depth; wall-hung units shall be 15 inches minimum overall depth.
 - b. At concealed locations, provide tops on all wall-hung and tall cabinets utilizing melamine on both faces.
 - c. At locations where the tops of wall hung or tall cabinets are visible, provide tops on all wall-hung and tall cabinets utilizing HPL on exterior face and melamine on interior face.
 - d. Fabricate bottoms, tops and frames of lock-joint glued and screwed, or dowelled and glued construction to end panel construction. Simple butted not permitted.
 - e. Tops and sides of tall units and wall-hung cabinets shall be 3/4-inch thick MDF core.
 - f. Bottoms of upper cabinets shall be constructed of same materials as specified for shelving.
 - g. Tall cabinets and base cabinets, fronts and sides shall be 3/4-inch thick MDF core.
 - h. Cabinet backs shall be a minimum of 1/4-inch thick.
 - i. Dowel and screw partitions and boxed shelves into top framing, bottoms or ends, as applicable.
 - j. Middle shelf of tall cabinets shall be fixed.
 - k. At top of counter height units, provide 3/4-inch plywood boxed subframe, mortised and tenoned, glued and screwed, for concealed attachment of countertop and for cabinet rigidity.
 - l. Provide toe space on floor-mounted units.
 - m. For tall units and wall-mounted cabinets, include 5/8 inch x 3 inch concealed wood strips full length at top and bottom, for screw or bolt anchorage to wall to conform to pull requirements of Title 24.
 - n. Holes for Shelf Support Clips: 32mm on center.
 - 1) Provide 2 holes on each side of shelf except provide a 3rd hole where cabinets are deeper than 24 inches.
 - 2) Locations shall be confirmed with Architect.
 - o. The fabrication of casework must allow for shim space at the base of the cabinets, to account for field conditions, as required so that the height from finish floor to top of counter, and sink rim where occurs, does not exceed the specified height at any location along the countertop after installation.
 2. Finishing:
 - a. Exposed Interior Surfaces and Semi-Exposed Surfaces:

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- 1) Melamine bonded to MDF core; specified TFM panel.
- 2) Use for all semi-exposed surfaces, tops and bottoms of wall-hung and tall cabinets except as otherwise specified, concealed ends, partitions, and drawer boxes.
- 3) See "Shelves" Paragraph for panel and finish requirements for shelving

E. Fabrication of Drawers:

1. Fabrication:
 - a. Fabricate and assemble drawer boxes with subfront and back glued and screwed into tenons at drawer sides.
 - b. Fronts shall be 3/4 inch thick MDF.
 - c. Sides: 1/2 inch thick MDF to create drawer box subfront, sides, back and bottom.
 - d. Extend bottom into dados with glue and screws at all 4 edges, using 1/4-inch materials matching the sides and backs.
 - e. At drawers over 30 inches wide, provide 1/2-inch bottoms.
 - f. Install 2-drawer guides for each drawer with positive closing and stop device to prevent inadvertent removal.
 - g. Drawer boxes to be full height of drawer opening.
 - h. Attach drawer front to subfront with #8 x 1-inch pan head wood screws (P.H.W.S.)
 - i. Provide closing stops at the rear of both drawer sides, unless stops are built into the slides to prevent the drawer front from impacting the cabinet body.
2. Finishing:
 - a. Drawer Front: Vertical grade high-pressure laminate (HPL).
 - b. Interior Face of Drawer Front: Cabinet liner.
 - c. Band all 4 edges of drawer front with specified banding material.
3. Provide TFM panel with melamine finish on both faces, for subfront, sides, back and bottom

F. Fabrication of Doors:

1. Fabrication:
 - a. Panel: 3/4-inch thick MDF.
 - b. Hang face-mounted over cabinet, pairs parallel with proper clearance at pull edges. Install hardware.
 - c. Clearance Tolerances: Develop 1/8 inch maximum reveals.
2. Finishing:
 - a. Exposed Exterior Face: Specified HPL.
 - 1) Where wood grain pattern is selected, provide pairs of doors with book- match wood grain patterns.
 - b. Exposed Interior Face: Cabinet liner.
3. Band all 4 edges of doors with specified banding material

G. Fabrication of Shelves

1. Fabrication - General:

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- a. Shelving to be adjustable on 1-1/4 inch centers supported by 4 adjustable shelf clips.
 - b. Loading capacity to be minimum 50 pounds per square foot, not to exceed 200 pounds on any shelf.
 - c. Shelving shall match the interior depth of the cabinet box.
 - d. Band all leading edges with edge banding material as specified.
 2. Shelving less than 24 inches: 3/4-inch MDF.
 - a. Finish: Melamine, both sides.
 3. Shelving 24 to 30 inches: 1-inch MDF.
 - a. Finish: Melamine, both sides.
 4. Shelving Greater than 30 inches, up to 36 inches: 1-inch, MDF.
 - a. Finish: Vertical grade HPL, both sides, applied with rigid glue line process.
 5. Shelving Greater than 36 inches, up to 48 inches: 1-inch plywood.
 6. Finish: Vertical grade HPL, both sides, applied with rigid glue line process. Contact adhesive is not permitted
- H. Fabrication of Scribes and Filler Panels:
1. Provide matching scribes and filler panels, and scribe all cabinets to abutting walls, partitions and ceilings.
 2. Scribes shall not exceed 1-1/2 inches wide.
 3. Scribe to be covered top and bottom.
 4. At locations where casework wraps inside corners, provide top and bottom filler panels where voids occur
- I. Fabrication of Cabinet Bases:
1. If casework manufacturer chooses to use cabinet bases, they shall be 4 inches standard height.
 2. Fabricate completely out of 3/4-inch plywood in continuous lengths to insure straight and level installation of cabinet bodies. MDF is not acceptable for use at bases.
 3. Freestanding cabinets shall have cabinet ends running directly to the floor.
 4. Anchorage fasteners to be neatly installed through the back and anchor strip at the top and bottom, and middle at tall cabinets
- J. Fabrication of Countertops:
1. General:
 - a. Obtain field measurements, and verify dimensions before fabricating work.
 - b. Comply with NAAWS Custom Grade requirements and ANSI A161.2.
 2. Core Material: Specified MDF.
 3. Fabricate to dimensions, profiles, and details shown.
 4. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.
 5. Provide specified backing sheet at configurations and installation conditions recommended in the woodworking standard.

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6. Countertops with Sinks: Provide no-drip roll-form edge, and 4-inch high —coved backsplashes and returns for full length of counter, including counters that wrap around corners, and where shown. Inside corners at backsplashes shall be coved.
 7. All other Countertops: Provide straight edge with 3mm edge banding.
 8. Unless otherwise shown, round projecting or outside corners, including wall caps, with 3/4-inch minimum radius or clip 45-degree angle corner.
 9. Provide joints only where maximum available lengths or countertop configuration requires a joint and where interfacing with existing. Where joints are required, balance and center. Make joints neat, flush and watertight.
 10. To greatest extent possible, complete fabrication and assembly before shipment to site.
 - a. Disassemble components only as necessary for shipment and installation.
 - b. Where necessary for fitting at site, provide extra borders and edges so as to allow scribing and trimming to fit.
- K. Precut openings for applied fixtures and fitting, where possible. Field cuts shall be performed by the fabricator.
- L. Conceal all fasteners
- M. General:
 1. Obtain field measurements, and verify dimensions before fabricating work.
 2. Comply with NAAWS Custom Grade requirements and ANSI A161.2.
- N. Core Material: Specified MDF.
- O. Fabricate to dimensions, profiles, and details shown.
- P. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.
- Q. Provide specified backing sheet at configurations and installation conditions recommended in the woodworking standard.
- R. Countertops with Sinks: Provide no-drip roll-form edge, and
- S. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

Retain first subparagraph below if Architect will examine work in woodwork shop before it is shipped to Project site.

1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.

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- T. Retain subparagraph below for high-quality and large or complex work.
 - 1. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- U. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installing casework, examine and verify that the installed work of all other trades is complete to the point where this work may properly commence.
- B. Verify that specified items may be installed in accordance with the approved design.
- C. Review in job conditions, installation requirements, and quality of completed substrate for compliance with Architect's expectations related to floor flatness for installation of casework.
- D. In the event of discrepancy, immediately notify the Architect. Do not proceed in discrepant areas until discrepancies have been fully resolved

3.02 PREPARATION

- A. Take all necessary measurements in the field to ensure proper dimensions for cabinets prior to fabrication.
- B. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- C. Where substrate is not in compliance with Architect's expectations related to floor flatness for installation of casework, and where excessive shimming to meet these expectations would be required, level substrate using latex-modified, portland cement based or blended hydraulic-cement-based formulation.

3.03 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

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- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with cabinet surface.
 - 1. For shop-finished items, use filler matching finish of items being installed.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Maintain veneer sequence matching of cabinets with transparent finish.
 - 4. Fasten wall cabinets as shown on drawings.

3.04 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through WI's Monitored Compliance Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
 - 1. Inspection entity shall prepare and submit report of inspection.

3.05 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Prior to final inspection and acceptance by the Architect, completely check each installed item and adjust for proper operation
- C. Remove all fingerprints, smudges and the like from casework; vacuum clean drawers and interiors of dust, dirt and sawdust
- D. Clean, lubricate, and adjust hardware.
- E. Clean cabinets on exposed and semiexposed surfaces. Touch up finishes to restore damaged or soiled areas.

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3.06 PROTECTION

- A. Protect work and materials of this Section prior to and during installation and protect the installed work and materials of other trades. Adjust all moving or operating parts to function smoothly and correctly.
- B. In the event of damage, make all repairs and replacements necessary to the approval of the Architect at no additional cost to the Owner.

END OF SECTION

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SECTION 06 64 00 - PLASTIC PANELING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Plastic sheet paneling.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Section 10 26 00 "Wall and Door Protection" for corner guards installed over plastic paneling.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.
- C. Shop Drawings: Submit showing all components, panel joint and end conditions, adjacent materials, and including the following.
 - 1. Dimensioned plans and elevations, drawn to scale.
 - 2. Large-scale details identifying components used and indicating method of attachment.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for adhesives and sealants, indicating VOC content.

1.04 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide products as indicated, or comparable products by one of the following:
 - 1. Altro.

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2. Marlite.
3. Nudo Products, Inc.

- B. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
1. Adhesives:
 - a. VOC content limits for field applications.

2.03 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.
1. Basis-of-Design Product: As indicated on Drawings.
 2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 200 or less.
 - b. Smoke-Developed Index: 450 or less.
 3. Nominal Thickness: Not less than 0.09 inch.
 4. Surface Finish: As indicated by manufacturer's designations.
 5. Color: As indicated by manufacturer's designations.

2.04 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard aluminum extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
1. Color and Finish: Clear anodized .
- B. Adhesive: As recommended by plastic paneling manufacturer.
- C. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints where indicated.
 - 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
 - 2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.03 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Set panels on top of flooring base. Secure to walls with adhesive.
- C. Install panels in a full spread of adhesive.
- D. 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.
- E. Install trim accessories with adhesive.
- F. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

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- I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

3.04 CLEANING AND ADJUSTING

- A. Upon completion of installation, remove manufacturer's labels and marks of identification.
- B. Thoroughly wash surfaces and remove foreign material. Leave entire work in neat, orderly, clean and acceptable condition.
- C. Replace damaged parts and surfaces, which are not free from imperfections.

3.05 PROTECTION

- A. Protect work and materials of this Section prior to and during installation and protect the installed work and materials of other trades.
- B. In the event of damage, make all repairs and replacements necessary to the approval of the Architect at no additional cost to the Owner.
- C. Exposed finishes shall be free from scratches, dents, permanent discolorations and other defects in workmanship or material.

END OF SECTION

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Sealant and backing materials.
 - 2. Acoustical sealants.

- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.

- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for sealants, indicating VOC content.

- B. Product Test Reports: For each kind of joint sealant.

- C. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

- D. Sample Warranties: For special warranties.

1.04 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.

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3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry substrates.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

1.05 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.06 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period:
 - a. Silicone Sealants: 20 years from date of Substantial Completion.
 - b. All Other Sealants: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
1. Sealants:
 - a. VOC content limits for field applications.

2.02 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

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2.03 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- C. Nonstaining Joint Sealants: Where sealants are indicated to be nonstaining, provide products that exhibit no staining of substrates when tested according to ASTM C1248.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with the following public health and safety requirements:
 - 1. Sealant is certified for compliance with NSF standards for end-use application indicated.
 - 2. Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.
- E. Mildew-Resistant Joint Sealants: Where sealants are indicated to be mildew-resistant, provide products formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- F. Colors of Exposed Joint Sealants: Custom colors, as directed by Architect.

2.04 JOINT SEALANTS

- A. Silicone: Mildew-resistant, single-component, nonsag, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Joint Locations: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces, and as follows:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints in wet locations.
 - c. Other joints as indicated on Drawings.
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
 - b. The Dow Chemical Company; DowSil 786.
- B. Urethane: Multicomponent, nonsag, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT.

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1. Joint Locations: Interior joints in horizontal traffic surfaces, and as follows:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation; MasterSeal NP 2.
 - b. LymTal International Inc; Iso-Flex 881 or Iso-Flex 885 SG.
 - c. Pecora Corporation; Dynatred.
 - d. Sika Corporation; Joint Sealants; Sikaflex 2c NS TG.
- C. Urethane: Single-component, nonsag, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Joint Locations: Interior joints in vertical surfaces and horizontal nontraffic surfaces, and as follows:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry walls.
 - d. Other joints as indicated on Drawings.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Pecora Corporation; Dynatrol I-XL.
 - b. Polymeric Systems, Inc; Flexiprene 1000.
 - c. Sika Corporation; Joint Sealants; Sikaflex Textured Sealant.
 - d. Tremco Incorporated; Dymonic.
- D. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
1. Joint Locations: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement, and as follows:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors windows glazed framing systems.
 - c. Other joints as indicated on Drawings.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation; MasterSeal NP 520.
 - b. Bostik, Inc.; Bosti-Flex Plus.
 - c. Pecora Corporation; AC-20.
 - d. Tremco Incorporated; Tremflex 834.
- E. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.
1. Joint Locations: Interior, exposed sawcuts and non-moving control joints in concrete slabs.
 2. Color: As selected by Architect from manufacturer's full range.

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3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. BASF Corporation; MasterSeal CR 190.
 - b. Sika Corporation; Joint Sealants; Sikadur 51.

2.05 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834. Sealant effectively reduces airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.
 1. Joint Location:
 - a. Acoustical joints where indicated.
 - b. Other joints as indicated.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; RCS20 Acoustical.
 - c. Grabber Construction Products; Acoustical Sealant GSC.
 - d. Hilti, Inc.; CP 506 Smoke and Acoustical Sealant.
 - e. Pecora Corporation; AC-20 FTR.
 - f. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - g. Tremco Incorporated; Tremflex 834.

2.06 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), unless otherwise recommended by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.07 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

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- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.02 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

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- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

- G. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters including heads of walls, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

3.03 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION

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SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Standard hollow-metal doors and frames.
- B. Related Sections:
 - 1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.

1.02 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.03 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.

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- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.01 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. Ceco Door; AADG, Inc.; ASSA ABLOY.
 - 2. Curries, AADG, Inc.; ASSA ABLOY Group.
 - 3. DCI Hollow Metal on Demand.
 - 4. Deansteel Manufacturing Company, Inc.
 - 5. Mesker Door; Mesker Openings Group.
 - 6. Republic Doors and Frames; a Allegion brand.
 - 7. Security Metal Products; a brand of ASSA ABLOY.
 - 8. Steelcraft; Allegion plc.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.03 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

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- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.
1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - f. Core: Manufacturer's standard .
 - g. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
 2. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Knocked down.
 3. Exposed Finish: Prime.

2.04 FRAME ANCHORS

- A. Jamb Anchors:
1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, full width of frame, 0.067 inch thick steel.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
1. For 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.

2.05 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

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- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- E. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.06 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.07 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

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2.08 LOUVERS

- A. Provide louvers for interior doors, where indicated, 18 ga, non-vision, inverted split "Y louver with 12 ga security grille two sides, prime coat finish for field painting. Provide optional galvanized attached mesh insert screen. size as shown on drawings.
- B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.02 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames according to NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

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6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.

3.03 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.04 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

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END OF SECTION

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SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Access doors and frames for walls and ceilings.

1.02 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

PART 2 - PRODUCTS

2.01 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- 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. Acudor Products, Inc.
 2. Babcock-Davis.
 3. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 4. Karp Associates, Inc.
 5. Larsen's Manufacturing Company.
 6. MIFAB, Inc.
 7. Milcor Inc.
 8. Nystrom, Inc.
 9. Williams Bros. Corporation of America (The).
- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- C. Flush Access Doors with Concealed Flanges :
1. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
 2. Locations: Wall and ceiling.
 3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
 - a. Finish: Factory prime.
 4. Frame Material: Same material and thickness as door.
 5. Hinges: Manufacturer's standard.
 6. Hardware: Lock.

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- D. Hardware:
 - 1. Lock: Cylinder.
 - a. Lock Preparation: Prepare door panel to accept cylinder specified in Division 08 Section "Door Hardware."

2.02 MATERIALS

- A. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- B. Frame Anchors: Same type as door face.
- C. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.03 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder locks, furnish two keys per lock and key all locks alike.

2.04 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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- D. Steel and Metallic-Coated-Steel Finishes:
1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.02 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

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SECTION 08 35 16 – ACCORDION FOLDING GRILLES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes open-curtain accordion folding grilles.

1.02 SUBMITTALS

- A. Product Data: For each type and size of accordion folding grille and accessory.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 2. Show locations of controls, locking devices, and other accessories.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance data.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Accordion folding grilles shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.02 ACCORDION FOLDING GRILLE ASSEMBLY

- A. Glazed Grille: Accordion folding grille with a curtain having aluminum-framed glazed panels.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Cornell Iron Works, Inc; VistaPane Side Folding Grilles, or comparable product by one of the following:
 - a. AlumaTek, Inc.
 - b. City-Gates.
 - c. Cookson Company.
 - d. Dynamic Closures Corp.

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- e. Metro Door.
 - f. Overhead Door Corporation.
- B. Grille Curtain Material: Aluminum.
- 1. Panel Width: 7 inches nominal.
- C. Glazing Material: Tempered glass.
- D. Curtain Posts: Aluminum with exposed finish matching curtain material; manufacturer's standard types for configuration and locking indicated.
- 1. Provide intermediate posts at not more than 13-foot spacing for curtain length.
- E. Tracks: Aluminum with exposed finish matching curtain material. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- 1. Roller Assemblies: Manufacturer's standard.
- F. Jamb Channel: Manufacturer's standard full-height channel.
- G. Locking Devices: Equip grille with locking device assembly.
- 1. Locking Device Assembly: Leading post locking bars.
 - 2. Provide floor drop bolt at intermediate posts and end posts.
- H. Grille Finish:
- 1. Aluminum Finish: Clear anodized.
- 2.03 GRILLE CURTAIN MATERIALS AND CONSTRUCTION
- A. Fabricate with every fourth vertical rod as a hanger rod. Provide tube spacers at each hanger rod to maintain chain spacing.
- B. Hinge Panels: Continuous rows between top two and bottom two chain sets.
- C. Bi-Parting Grilles: Attach strike channel to appropriate curtain section.
- D. Tracks: Manufacturer's standard shape having curtain groove with return lips or bars to retain curtain. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise; with removable stops on track to prevent overtravel of curtain.
- 2.04 LOCKING DEVICES
- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
- 1. Lock Cylinders: Cylinders specified in Section 08 71 00 "Door Hardware".

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PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install accordion folding grilles and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports, according to manufacturer's written instructions and as specified.
- B. Adjust hardware and moving parts to function smoothly, so that grilles operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer.

3.02 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain accordion folding grilles.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following, but is not necessarily limited to:
 - 1. Door Hardware, including electric hardware.
 - 2. Thresholds, gasketing and weather-stripping.
 - 3. Door silencers or mutes.
- C. Related Sections: The following sections are noted as containing requirements that relate to this Section, but may not be limited to this listing.
 - 1. Division 8: Section - Steel Doors and Frames.
 - 2. Division 8: Section - Wood Doors.

1.03 REFERENCES (USE DATE OF STANDARD IN EFFECT AS OF BID DATE.)

- A. 2022 California Building Code, CCR, Title 24.
- B. BHMA – Builders' Hardware Manufacturers Association
- C. CCR – California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.
- D. DHI – Door and Hardware Institute
- E. NFPA - National Fire Protection Association.
 - 1. NFPA 80 - Fire Doors and Other Opening Protectives
 - 2. NFPA 105 - Smoke and Draft Control Door Assemblies
- F. UL - Underwriters Laboratories.
 - 1. UL 10C - Fire Tests of Door Assemblies
 - 2. UL 305 - Panic Hardware
- G. WHI - Warnock Hersey Incorporated
- H. SDI - Steel Door Institute

1.04 SUBMITTALS & SUBSTITUTIONS

- A. General: Submit in accordance with Conditions of the Contract and Division 1 Specification sections.
- B. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- C. Submit schedule organized vertically into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:
 - 1. Include a Cover Sheet with;
 - a. Job Name, location, telephone number.
 - b. Architects name, location and telephone number.
 - c. Contractors name, location, telephone number and job number.
 - d. Suppliers name, location, telephone number and job number.
 - e. Hardware consultant's name, location and telephone number.
 - 2. Job Index information included;
 - a. Numerical door number including; door number, hardware heading number and page number.
 - b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying information when available; if it is not available at the time the preliminary schedule is submitted.
 - c. Manufacturers' names and abbreviations for all materials.
 - d. Explanation of abbreviations, symbols, and codes used in the schedule.
 - e. Mounting locations for hardware.
 - f. Clarification statements or questions.
 - g. Catalog cuts and manufacturer's technical data and instructions.
 - 3. Vertical schedule format sample:

Heading Number 1 (Hardware group or set number – HW -1)					
			(a) 1 Single Door #1 - Exterior from Corridor 101	(b) 90°	(c) RH
			(d) 3' 0"x7' 0" x 1-3/4" x (e) 20 Minute (f) WD x HM		
(g) 1	(h)	(i) ea	(j) Hinges - (k) 5BB1HW 4.5 x 4.5 NRP (l) ½ TMS	(m) 626	(n) IVE
2	6AA	1 ea	Lockset - ND50PD x RHO x RH x 10-025 x JTMS	626	SCH

(a) - Single or pair with opening number and location. (b) - Degree of opening (c) - Hand of door(s) (d) - Door and frame dimensions and door thickness. (e) - Label requirements if any. (f) - Door by frame material. (g) - (Optional) Hardware item line #. (h) - Keypad Symbol. (i) - Quantity. (j) - Product description. (k) - Product Number. (l) - Fastenings and other pertinent information. (m) - Hardware finish codes per ANSI A156.18. (n) - Manufacture abbreviation.

- D. Make substitution requests in accordance with Division 1. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.

- E. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- F. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- G. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.
- H. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.
- I. LEED Certification Points: Submit information and certifications necessary to achieve maximum points for LEED certification; coordinate and cooperate with Owner and Architect in providing information necessary for required LEED rating.

1.05 QUALITY ASSURANCE

- A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
 - 1. Responsible for detailing, scheduling and ordering of finish hardware.
 - 2. Meet with Owner to finalize keying requirements and to obtain final instructions in writing. To maintain the integrity of patented key systems provide a letter of authorization from the specified manufacturer indicating that supplier has authorization to purchase the key system directly from the manufacturer.
 - 3. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.
- C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.
- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.
 - 1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".
- E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

- F. Product packaging to be labelled in compliance with CA Prop 65, Safe Drinking Water and Toxic Enforcement Act of 1986.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.
- B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.
- C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.
- D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.

1.07 WARRANTY

- A. Provide warranties of respective manufacturers' regular terms of sale from day of final acceptance as follows:
 - 1. Mechanical Locksets: Ten (10) years.
 - 2. Closers: Thirty (30) years.
 - 3. All other hardware: Three (3) years.

1.08 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.09 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference at least one week prior to beginning work of this section.
- B. Attendance: Architect, Construction Manager, Contractor, Security Contractor, Hardware Supplier, Installer, Key Owner Personnel, and Project Inspector.
- C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review Owner's keying standards.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

<u>Item</u>	<u>Manufacturer</u>	<u>Acceptable Substitutes</u>
Hinges	Ives	Hager, Stanley, McKinney
Locks, Latches & Cylinders	Schlage	Or Approved Equal

Closers	LCN	Or Approved Equal
Protection Plates	Ives	Trimco, BBW, DCI
Stops	Ives	Trimco, BBW, DCI
Seals & Bottoms	Zero	Pemko, National Guard

2.02 MATERIALS

- A. Hinges: Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.
1. Hinges shall be sized in accordance with the following:
 - a. Height:
 - 1) Doors up to 42" wide: 4-1/2" inches.
 - 2) Doors 43" to 48" wide: 5 inches.
 - b. Width: Sufficient to clear frame and trim when door swings 180 degrees.
 - c. Number of Hinges: Furnish 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.
 2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.
- B. Heavy Duty Cylindrical Locks and Latches: Schlage "ND" Series as scheduled with "Rhodes" design, fastened with through-bolts and threaded chassis hubs.
1. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
 - a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
 - b. Offset lever pull – minimum 1,600 foot pounds without gaining access
 - c. Vertical lever impact – minimum 100 impacts without gaining access
 2. Cycle life - tested to minimum 16 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers
 3. UL 10C for 4'-0" x 10'-0" 3-hour fire door.
 4. Cylinders: Refer to "KEYING" article, herein.
 5. Provide solid steel anti-rotation through bolts and posts to control excessive rotation of lever.
 6. Provide lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.
 7. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw capable of UL listing of 3 hours on a 4' x 10' opening. Provide proper latch throw for UL listing at pairs.
 8. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
 9. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
 10. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 11. Provide wired electrified options as scheduled in the hardware sets.
 - a. 12 through 24 volt DC operating capability, auto-detecting
 - b. Selectable EL (fail safe)/EU (fail secure) operating mode via switch on chassis
 - c. 0.230A (230mA) maximum current draw
 - d. 0.010A (10mA) holding current
 - e. Modular / "plug in" request to exit switch

12. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
- C. Schlage "L" Series as scheduled with "06" Style Lever and "A" Style Rose.
1. Locksets to comply with ANSI A156.13, Series 1000, Operational Grade 1 and Security Grade 1 with all standard trims. Locksets shall also comply with UL10C Positive Pressure requirements
 2. Lock case shall be manufactured with heavy 12 gauge steel with fully wrapped design. Lock cases with exposed edges are not acceptable. Lock case shall be multi-functional allowing transformation to a different function without opening lock case.
 3. Latchbolt shall have $\frac{3}{4}$ " throw and be non-handed, field reversible without opening the lock case. Solid latchbolts and / or plastic anti-friction devices are not acceptable.
 4. The deadbolt, when used, shall be 1" throw stainless steel with a $\frac{3}{4}$ " internal engagement when fully extended.
 5. All trim shall be through-bolted with the spring cages supporting the trim attached to the lock cases to prevent torquing.
 6. Levers to have independent rotation in both directions. Exterior lever assembly to be one-piece design attached by threaded bushing. Interior lever assembly shall be attached by screwless shank
 7. Thru-bolt lever assemblies through the door for positive interlock. Locks using a through the door spindle for attachment are not acceptable. Spindles shall be independent, designed to "break-away" at a maximum of 75psi torque.
 8. Hand of lock chassis to be changeable by simply moving one screw from one side to the case to the other and pulling and reversing the latchbolt.
 9. Cylinders to be secured by a cast stainless steel, dual retainer. Locks utilizing screws and / or stamped retainers are not acceptable.
- D. Deadlocks: Rotating cylinder trim rings of attack-resistant design. Mounting plates and actuator shields of plated cold-rolled steel. Mounting screws of $\frac{1}{4}$ " diameter steel and protected by drill-resistant ball bearings. Steel alloy deadbolt with hardened steel roller. Strike alloy deadbolt with reinforcer and two 3" long screws. ANSI A156.5, 2001 Grade 1 certified.
- E. Closers: LCN as scheduled. Place closers inside building, stairs, room, etc.
1. Door closer cylinders shall be of high strength cast iron construction with double heat treated pinion shaft to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.
 2. All door closers shall be fully hydraulic and have full rack and pinion action with a shaft diameter of a minimum of $\frac{11}{16}$ inch and piston diameter of 1 inch to ensure longevity and durability under all closer applications.
 3. All parallel arm closers shall incorporate one piece solid forged steel arms with bronze bushings. $\frac{1-9}{16}$ " steel stud shoulder bolts, shall be incorporated in regular arms, hold-open arms, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, durability, and aesthetics for versatility of trim accommodation, high strength and long life.
 4. All parallel arm closers so detailed shall provide advanced backcheck for doors subject to severe abuse or extreme wind conditions. This advanced backcheck shall be located to begin cushioning the opening swing of the door at approximately 45 degrees. The intensity of the backcheck shall be fully adjustable by tamper resistant non-critical screw valve.
 5. Closers shall be installed to permit doors to swing 180 degrees.

6. All closers shall utilize a stable fluid withstanding temperature range of 120 degrees F. to -30 degrees F. without requiring seasonal adjustment of closer speed to properly close the door.
7. Provide the manufactures drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed.
8. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. Per 11B-404.2.8.1, door shall take at least 5 seconds to move from an open position of 90 degrees to a position of 12 degrees from the latch jamb.

F. Door Stops:

1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
3. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

G. Protection Plates: Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10" high and 2" LDW. Sizes of armor and mop plates shall be listed in the Hardware Schedule. Furnish with machine or wood screws of bronze or stainless to match other hardware.

H. Seals: Provide silicone gasket at all rated and exterior doors.

1. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements.
2. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C Classified complies with NFPA 80 & NFPA 252. Where required, intumescent seals vary in requirement by door type and door manufacture -- careful coordination required.
3. Smoke & Draft Control Doors, Provide UL10C Classified complies with NFPA 80 & NFPA 252 for use on "S" labeled Positive Pressure door assemblies.

I. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

2.03 KEYING

- A. Furnish a Proprietary Schlage masterkey system as directed by the owner or architect. Key system to be designated and combined by the Schlage Master Key Department even if pinned by the Authorized Key Center, Authorized Security Center or a local authorized commercial dealer.
- B. A detailed keying schedule is to be prepared by the owner and/or architect in consultation with a representative of Allegion or an Authorized Key Center or Authorized Security Center.

Each keyed cylinder on every keyed lock is to be listed separately showing the door #, key group (in BHMA terminology), cylinder type, finish and location on the door.

- C. Establish a new masterkey system for this project as directed by the keying schedule.
- D. Furnish all cylinders in the Schlage conventional style except the exit device and removable mullion cylinders which will be supplied in Schlage Full Size Interchangeable Core (FSIC). Pack change keys independently (PKI).
- E. Furnish construction keying for doors requiring locking during construction.
- F. Furnish all keys with visual key control. (Not all options listed below are available at the same time.)
 - 1. Stamp key "Do Not Duplicate".
 - 2. Stamp (BHMA) key symbol on key.
- G. Furnish all cylinders with visual key control.
 - 1. Stamp (BHMA) key symbol on side of cylinder (CKC).
- H. Furnish mechanical keys as follows:
 - 1. Furnish 2 cut change keys for each different change key code.
 - 2. Furnish 1 uncut key blank for each change key code.
 - 3. Furnish 6 cut masterkeys for each different masterkey set.
 - 4. Furnish 3 uncut key blanks for each masterkey set.
 - 5. Furnish 2 cut control keys cut to the top masterkey for permanent I/C cylinders.
 - 6. Furnish 1 cut control key cut to each SKD combination.
 - 7. Furnish KS43D2200 padlock for use with non-I/C Schlage cylinders. Furnish 47-413 (conventional) or 47-743-XP (PrimusXP) with above.
 - 8. Furnish KS43G3200 padlock for use with FSIC Schlage cylinders. Furnish 23-030 (Classic / Everest) or 20-740 (PrimusXP) with above.
 - 9. Furnish KS41D1200 padlock for use with SFIC Schlage cylinders. Furnish 80-037 (Everest-B) with above.
- I. Furnish Schlage Padlocks and the cylinders to tie them into the masterkey system for gates, storage boxes, utility valve security, roof hatches and roll-up doors keyed as directed in the keying schedule.
 - 1. Furnish KS43G3200 padlock for use with FSIC Schlage cylinders. Furnish 20-740 with above.
- J. Furnish one Schlage cabinet lock for each cabinet door or drawer so designated on the drawings or keying schedule to match the masterkey system.
 - 1. Furnish CL771R for use with FSIC Schlage cylinders.

2.04 FINISHES

- A. Generally to be satin chrome US26D (626 on bronze and 652 on steel) unless otherwise noted.
- B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.

- C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.
- D. Aluminum items to be finished anodized aluminum except thresholds which can be furnished as standard mill finish.

2.05 FASTENERS

- A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.
- B. Screws for butt hinges shall be flathead, countersunk, full-thread type.
- C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.
- D. Provide expansion anchors for attaching hardware items to concrete or masonry.
- E. All exposed fasteners shall have a phillips head.
- F. Finish of exposed screws to match surface finish of hardware or other adjacent work.
- G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.
- B. Beginning of installation means acceptance of existing conditions.
- C. Fire-Rated Door Assembly Inspection: Upon completion of the installation, all fire door assemblies shall be inspected to confirm proper operation of the closing device and latching device and that only the manufacturer's furnished fasteners are used for installation and that it meets all criteria of a fire door assembly per NFPA 80 (Standard for Fire Doors and Other Opening Protectives) 2016 Edition. A written record shall be maintained and transmitted to the Owner to be made available to the Authority Having Jurisdiction (AHJ). The inspection of the swinging fire doors shall be performed by a certified FDAI (Fire Door Assembly Inspector) with knowledge and understanding of the operating components of the type of door being subjected to the inspection. The record shall list each fire door assembly throughout the project and include each door number, an itemized list of hardware set components at each door opening, and each door location in the facility.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and requirements of DHI.
- B. Use the templates provided by hardware item manufacturer.
- C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute. Operating hardware will to be located between 34" and 44" AFF.

- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Set thresholds for exterior doors in full bed of butyl-rubber sealant.
- G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.

3.03 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surface soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.04 HARDWARE LOCATIONS

- A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

3.05 FIELD QUALITY CONTROL

- A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers' instructions and as specified herein.

3.06 SCHEDULE

- A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.
- B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for

examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called to the attention of the Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.

C. The Door Schedule on the Drawings indicates which hardware set is used with each door.

Manufacturers Abbreviations (Mfr.)

IVE	=	Ives	Hinges, Protection Plates, & Door Stops
LCN	=	LCN	Door Closers
SCH	=	Schlage Lock Company	Locks, Latches & Cylinders
ZER	=	Zero International	Thresholds, Gasketing & Weather-stripping

HARDWARE GROUP NO. 01

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94P6D RHO	626	SCH
1	EA	PRIMUS K-I-L CYL.	20-765	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA (MOUNT PULL SIDE)	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HARDWARE GROUP NO. 02

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY W/INDICATOR	L9056P6 06A L583-363 OS-OCC	626	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA (MOUNT PULL SIDE)	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 5" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HARDWARE GROUP NO. 03

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM SEC	ND98P6D RHO 47342586	626	SCH
2	EA	PRIMUS K-I-L CYL.	20-765	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 5" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP/HOLDER	WS45	626	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

END OF SECTION

SACRAMENTO CITY UNIFIED SCHOOL DISTRICT
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DSA SUBMITTAL
18 SEPTEMBER 2024

SECTION 09 05 61.13 - MOISTURE VAPOR EMISSION CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Fluid-applied membrane-forming systems that control the moisture-vapor-emission rate of interior concrete installed as required prior to installation of floor coverings, floor coatings, and other flooring products and systems.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Division 09 Sections for flooring system substrate requirements.

1.02 DEFINITIONS

- A. MVE: Moisture vapor emission.
- B. MVER: Moisture vapor emission rate.

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for coatings, indicating VOC content.
- B. Product Test Reports: For each MVE-control system, for tests performed by a qualified testing agency.
- C. Preinstallation testing reports.
- D. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

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1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.07 FIELD CONDITIONS

- A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
 - 1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F and not more than 85 deg F at least 48 hours before use.
 - 2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F or more than 85 deg F and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace vapor retarder and floor coverings, floor coatings, and other flooring products and systems that fail due to moisture vapor emission and moisture born contaminates within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Coatings:
 - a. VOC content limits for field applications.

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2.02 PERFORMANCE REQUIREMENTS

- A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
 - 1. MVER: Maximum 25 lb of water/1000 sq. ft. when tested according to ASTM F1869.
 - 2. Relative Humidity: Maximum 90 percent when tested according to ASTM F2170 using in situ probes.
- B. Water-Vapor Transmission: Through MVE-control system, maximum 0.06 perm when tested according to ASTM E96/E96M.
- C. Tensile Bond Strength: For MVE-control system, greater than 200 psi with failure in the concrete according to ASTM D7234.
- D. Alkalinity Insensitivity: Insensitivity to alkaline environment up to, and including, pH 14 in a bath test when tested according to ASTM D1308.

2.03 MVE-CONTROL SYSTEM

- 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. Ardex.
 - 2. Aquafin Building Product Systems.
 - 3. KOSTER American Corporation.
 - 4. Sika Corporation.
 - 5. Synthetics International.
- B. MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.
 - 1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
 - 2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

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2.04 ACCESSORIES

- A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.
- B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.
- C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's cement-based underlayment.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of system indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Preinstallation Testing:
 - 1. Testing Agency: Engage a qualified testing agency to perform tests.
 - 2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
 - 3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.
 - 4. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. area of MVE-control system to prepared concrete substrate and test according to ASTM D7234.

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- a. Proceed with installation only where tensile bond strength is greater than 200 psi with failure in the concrete.

- B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
 - 1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
 - 2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - 3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
 - 4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
 - 5. Fill surface depressions and irregularities with patching and leveling material.
 - 6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
 - 7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
 - 8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.

- C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.03 INSTALLATION

- A. Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
 - 1. Install primers as required to comply with manufacturer's written instructions.

- B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.

- C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.

- D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.

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- E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.
- F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform installation inspections.
- B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
 - 1. Verify that surface preparation meets requirements.
 - 2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
 - 3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.
- C. MVE-control system will be considered defective if it does not pass inspections.

3.05 PROTECTION

- A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.
- B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION

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SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
- B. Related Sections:
 - 1. Section 07 92 00 "Joint Sealants" for acoustical sealants installed as part of STC-rated gypsum board assemblies.
 - 2. Section 09 30 00 "Tiling" for backer units installed as substrates for tile.

1.02 ACTION SUBMITTALS

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

1.03 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.04 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.01 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:

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1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Continental Building Products.
5. National Gypsum Company.
6. PABCO Gypsum.
7. USG Corporation.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.03 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
 1. Thickness: 5/8 inch.
 2. Long Edges: Tapered.

2.04 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.

2.05 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.

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3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

2.06 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound Attenuation Blankets: As specified in Division 09 Section "Acoustic Insulation."
- D. Acoustical Joint Sealant: As specified in Division 07 Section "Sealants."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

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- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.03 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

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- B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. U-Bead: Use at exposed panel edges where indicated.
 - 4. Curved-Edge Cornerbead: Use at curved openings.

3.04 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: Surfaces scheduled for light-textured finishes, wallcoverings, flat paints and panel surfaces that will be exposed to view, unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
 - 3. Level 5: Surfaces scheduled for gloss and semigloss coatings, wall and ceiling areas abutting window mullions or skylights, curved surfaces, long hallways, large surface areas flooded with artificial and/or natural lighting and where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- E. Curved Surfaces: In accordance with GA-226.

3.05 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

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- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Ceramic tile.
 - 2. Tile backing panels.
 - 3. Metal edge strips.

- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
 - 2. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.02 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product, including installation instructions.

- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Full-size units of each type of trim and accessory for each color and finish required.
 - 3. Metal edge strips in 6-inch lengths.

1.04 INFORMATIONAL SUBMITTALS

- A. Product Test Reports:
 - 1. Slip-resistance test reports from qualified independent testing agency.

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1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of each type of floor tile installation.
 - 2. Build mockup of each type of wall tile installation.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers for Setting and Grouting Materials:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ARDEX Americas.
 - b. Custom Building Products.
 - c. Laticrete International, Inc.
 - d. MAPEI Corporation.

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- B. Source Limitations for Setting and Grouting Materials: Obtain setting and grouting materials from single manufacturer and aggregate from single source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Backer units.
 - 2. Metal edge strips.

2.02 PERFORMANCE REQUIREMENTS

- A. Slip Resistance, Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products in accordance with the following:
 - 1. Level Surfaces, Dry and Wet: DCOF of not less than 0.42 in accordance with ANSI A326.3.

2.03 CERAMIC TILE PRODUCTS

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. Ceramic Tile: Vitreous or impervious natural clay or porcelain; 1/4 inch thick, unless otherwise indicated. As scheduled on Drawings:
 - 1. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as indicated on Drawings, selected from manufacturer's standard shapes:
 - a. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

2.04 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation; GlasRoc Tile Backer.
 - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
 - c. National Gypsum Company; eXP Tile Backer.
 - d. USG Corporation; Durock Glass-Mat Tile Backerboard.
 - 2. Core: 5/8 inch, Type X.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- B. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A.

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1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc; Util-A-Crete Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
2. Thickness: 5/8 inch.

2.05 SETTING MATERIALS

- A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
 1. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
 2. Basis of Design: "Kerabond/Keralastic System" by MAPEI Corporation.
 - a. Thin-Set Mortar gauged with "Keralastic Latex Additive."
 3. Subject to compliance with requirements, provide named product or one of the following:
 - a. Laticrete International, Inc., "254 Platinum."
 - b. "ArDEX X 77™ Microtec, Fiber Reinforced Tile and Stone Mortar."
 - c. Custom Building Products, "ProLite Premium Large Format Tile Mortar."
 4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- B. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.
 1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.06 GROUT MATERIALS

- A. Grout Colors: As indicated on Drawings.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
 1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.
 2. Basis of Design: "Kerapoxy Premium Epoxy Grout" by MAPEI Corporation.
 3. Subject to compliance with requirements, provide named product or one of the following:
 - a. Laticrete International, Inc., "SPECTRALOCK PRO Premium Grout."
 - b. "ArDEX WA, Epoxy Grout and Adhesive."
 - c. Custom Building Products, "CEG-Lite 100% Solids Commercial Epoxy Grout."

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2.07 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Profile as indicated, height to match tile and setting-bed thickness, designed specifically for tiling applications.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
 - 2. Exposed Finish: As selected by Architect from manufacturer's full range.
- C. Tile Protective Coating: Liquid grout-release coating that is formulated to protect exposed surfaces of stone tile and textured tile against adherence of mortar and grout.
 - 1. Compatible with mortar and grout products; easily removable after grouting is completed without damaging grout, stone tile or textured tile; and recommended for use as temporary protective coating for tile product.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.02 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with dry-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, pre-coat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.03 INSTALLATION OF TILE BACKING PANEL

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.04 TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches or larger.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

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- D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with joint widths as recommended by tile manufacturer.
- F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 - 2. Locate expansion joints as recommended by tile and tile installation material manufacturers, but not less than the following:
 - a. Interior Locations: 20-25 feet in each direction.
 - b. Interior Locations Exposed to Direct Sunlight or Moisture: 8-12 feet in each direction.
 - c. Perimeter joints.
- G. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

3.05 GROUT INSTALLATION

- A. Joints shall be packed full and free of all voids or pits, joints shall not be raked. Clean excess grout and mortar from tile surface with water as work progresses. Clean while mortar is fresh and before it hardens on the surface.
- B. Epoxy Grout: Install in accordance with ANSI A108.3 and ANSI A108.6 for epoxy grout and the manufacturer's recommended procedures and precautions during application and cleaning.

3.06 CLEANING AND PROTECTION

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.

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2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- C. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- E. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.07 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations:
 1. Ceramic Tile Over Concrete:
 - a. TCNA F113, F113A: On-ground and above-ground concrete.
 - 1) Mortar: Improved modified dry-set mortar.
 - a) Provide thinset mortar unless medium-bed mortar is recommended by tile or mortar manufacturer.
 - 2) Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations:
 1. Ceramic Tile Over Wood or Metal Studs:
 - a. TCNA W244C: Wood or metal studs; Cement backer board.
 - 1) Mortar: Modified dry-set mortar.
 - a) Provide thinset mortar unless medium-bed mortar is recommended by tile or mortar manufacturer.
 - 2) Grout: Water-cleanable epoxy grout.

END OF SECTION

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SECTION 09 51 23 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Acoustical tiles.
- B. Related Requirements:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

- A. Product Data:
 - 1. Acoustical tiles.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for adhesives, indicating VOC content.
 - 2. Documentation for acoustical ceiling tiles, indicating compliance with emissions testing or certification.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical tiles, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

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1.06 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated or comparable product by one of the following:
1. Armstrong World Industries, Inc.
 2. CertainTeed Corporation.
 3. Rockfon (Rockwool International).
 4. USG Corporation.
- B. Source Limitations:
1. Directly Attached Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile from single source from single manufacturer.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
1. Adhesives:
 - a. VOC content limits for field applications.
 2. Ceiling Products:
 - a. VOC emissions testing or certification.

2.03 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: Class A in accordance with ASTM E1264.
 2. Smoke-Developed Index: 50 or less.

2.04 ACOUSTICAL TILES

- A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264.
- B. Basis-of-Design Product: As indicated on Drawings.

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2.05 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.
 - 1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 - 2. Finish: Painted to match color of acoustical unit.

2.06 MISCELLANEOUS MATERIALS

- A. Acoustical Tile Adhesive: Type recommended in writing by acoustical tile manufacturer, bearing UL label for Class 0-25 flame spread.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Testing Substrates: Before adhesively bonding tiles to wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.
- B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- C. Layout openings for penetrations centered on the penetrating items.

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3.03 INSTALLATION OF DIRECTLY ATTACHED ACOUSTICAL TILE CEILINGS

- A. Adhesive Installation: Install acoustical tile by bonding to substrate, using acoustical tile adhesive and procedure recommended in writing by tile manufacturer and as follows:
 - 1. Wipe and prime ceiling.
 - 2. Remove loose dust from backs of tiles by brushing.
 - 3. Install splines in joints between tiles and maintain bottom surface to a uniform level. Shim tile or correct substrate as required to maintain levelness.
 - 4. Maintain tight butt joints, aligned in both directions and coordinated with ceiling fixtures.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical units.
- C. Arrange directionally patterned acoustical tiles as indicated on Drawings.

3.04 CLEANING

- A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 09 61 17 - CONCRETE FLOOR SEALING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fluid-applied, resin-based, membrane-forming concrete sealer systems.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For sealer showing gloss of topcoat.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for liquid floor treatments, indicating VOC content.
- B. Product Test Reports:
 - 1. Slip-resistance test reports from qualified independent testing agency.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.06 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.

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PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Liquid Floor Treatments:
 - a. VOC content limits for field applications.

2.02 PERFORMANCE REQUIREMENTS

- A. Slip Resistance, Coefficient of Friction: For sealers on walking surfaces, provide products with the following values as determined by testing identical products in accordance with the following:
 - 1. Level Surfaces, Dry and Wet: DCOF of not less than 0.42 in accordance with ANSI A326.3.

2.03 CONCRETE SEALER

- A. Polyurethane Polymer Sealer: Two-component polyurethane sealer, free of VOCs.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Duraflex; Accellera S or comparable product by one of the following:
 - a. Rust-Oleum Corporation.
 - 2. Color: Clear.
 - 3. Sheen: Match approved Sample.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of system indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Prepare surfaces according to manufacturer's written instructions and as follows:
 - 1. Remove delaminated material and deteriorated concrete surface material.
 - 2. Roughen surface of concrete to produce a surface profile matching CSP 3 according to ICRI 310.2.
 - 3. Sweep and vacuum roughened surface to remove debris.
 - 4. Conduct random tests for adequate bond strength while surface preparation is ongoing, in accordance with the Manufacturer's recommendations.

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3.03 SEALER APPLICATION

- A. General: Apply polymer sealer by brush, roller, or airless spray at manufacturer's recommended application rate.
- B. Polyurethane Polymer Sealer:
 - 1. Topcoat: Apply sealer in accordance with manufacturer's recommended application rate, in number of coats required, to achieve a minimum dry film thickness recommended by manufacturer for substrate indicated.

3.04 PROTECTION

- A. Protect sealer system from damage, wear, dirt, dust, and other contaminants. Use protective methods and materials, including temporary coverings, recommended in writing by system manufacturer.

END OF SECTION

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SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

B. Related Sections:

1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

1.03 INFORMATIONAL SUBMITTALS

A. Sustainable Design Submittals:

1. Documentation for adhesives, indicating VOC content.
2. Documentation for resilient base, indicating compliance with emissions testing or certification.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.05 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

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- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide product indicated, or comparable product by one of the following:
 - 1. Johnsonite.
 - 2. Mannington Commercial / Burke.
 - 3. Roppe.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Adhesives:
 - a. VOC content limits for field applications.
 - 2. Resilient Base:
 - a. VOC emissions testing or certification.

2.03 RESILIENT BASE

- A. Basis-of-Design Products: As indicated on Drawings.
- B. Product Standard: As follows:
 - 1. ASTM F1861, Type TP (rubber, thermoplastic).
- C. Style and Location:
 - 1. As indicated on drawings.
- D. Thickness: 0.125 inch.
- E. Height: As indicated on Drawings.
- F. Lengths: Coils in manufacturer's standard length. Cut lengths 48 inches long not permitted.
- G. Outside Corners: Job formed.
- H. Inside Corners: Job formed.

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I. Colors: As indicated by manufacturer's designations .

2.04 MOLDING ACCESSORIES

A. Description: Provide rubber molding accessories as follows:

1. As indicated on drawings.

B. Profile and Dimensions: As indicated.

C. Locations: Provide rubber molding accessories in areas indicated.

D. Colors and Patterns: As indicated by manufacturer's designations.

2.05 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Metal Edge Strips: Extruded aluminum with mill finish, nominal 2 inches wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

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- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate. Gaps between resilient base and substrates not permitted.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.03 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. With top set gauge, remove portion of back side of base to the bend. Make two relief cuts, one on each side of the bend at the bottom of the base. Remove a tapered piece from the bottom of the toe. Attach per manufacturer's instructions.
 - 2. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 3. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter corners to minimize open joints.

3.04 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.

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- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.05 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

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SECTION 09 67 23 - RESINOUS FLOORING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Resinous flooring systems.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of exposed finish required.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for floor coatings, indicating VOC content.
- B. Product Test Reports:
 - 1. Slip-resistance test reports from qualified independent testing agency.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.
- B. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each demonstration and training.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.06 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

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- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Floor Coatings:
 - a. VOC content limits for field applications.

2.02 PERFORMANCE REQUIREMENTS

- A. Slip Resistance, Coefficient of Friction: Provide products with the following values as determined by testing identical products in accordance with the following:
 - 1. Level Surfaces, Dry and Wet: DCOF of not less than 0.42 in accordance with ANSI A326.3.
- B. Flammability: Self-extinguishing according to ASTM D635.

2.03 MANUFACTURERS

- A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.04 RESINOUS FLOORING

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated on Drawings or comparable product by one of the following:
 - a. BASF Corporation.
 - b. Crossfield Products Corp.
 - c. Duraflex, Inc.
 - d. Sherwin-Williams Company, General Polymers.
 - e. Stonhard, Inc.
- B. System Characteristics:

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1. Color and Pattern: As selected by Architect from manufacturer's full range.
 2. Wearing Surface: Manufacturer's standard slip resistant wearing surface.
 3. Overall System Thickness: As indicated by product designation.
- C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
- D. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- E. Accessories and Additional Materials:
1. Vapor Dissipation System: Fluid-applied, modified epoxy moisture mitigation system specifically formulated for negative side application; Dex-O-Tex "VaporControl Primer 200E."
 2. Leveling Underlayment: Pre-mixed, polymer modified, cementitious compound; Dex-O-Tex "A81 Underlayment."
 3. Waterproofing and Anti-Fracture Membrane: 100 percent solids, fluid-applied, modified epoxy; Dex-O-Tex "Cheminert SC Membrane," or equal acceptable to epoxy flooring manufacturer. Waterproofing and Anti-Fracture Membrane is not required for slabs on grade. Fiberglass-reinforced epoxy is not acceptable.
- F. Anti-Microbial Additive: Factory-added, N-butyl-1,2-benzisothiazolin-3-one (BBIT); Dex-O-Tex "Antimicrobial Additive," or equal that will remain effective for the lifetime of the epoxy flooring

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with NACE No. 6/SSPC-SP13, with a Concrete Surface Profile (CSP) of 3 or greater in accordance with International Concrete Repair Institute (ICRI) Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.
 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.

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3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
 - b. Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- D. Vapor Dissipation System, if Required: Roller-apply vapor control primer to 7 mils thickness or as recommended by manufacturer for given conditions.
- E. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- 3.02 INSTALLATION
- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Reinforcing Membrane: Apply reinforcing membrane to substrate cracks.
- D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions. Round internal and external corners.
- E. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.

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1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
 - F. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.
 - G. Grout Coat: Apply 2 grout coats, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.
 - H. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.
 - I. Protect resinous flooring from damage and wear during the remainder of construction period.
- 3.03 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to repair each type of resinous flooring specified. Provide video training. Coordinate details with the construction manager.

END OF SECTION

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SECTION 09 72 00 - WALL COVERINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Vinyl wall covering.
- B. Related Sections:
 - 1. 09 9100 - Painting: For requirements for priming wall surfaces .

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For wall coverings and adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.
- D. Samples: 5 inch by 9 inch long section of wall covering from same print run or dye lot to be used for the Work, with specified treatments applied.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.
- B. Maintenance Data: For wall coverings to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.

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1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 1. Wood-Veneer Wall Coverings: Condition spaces for not less than 48 hours before installation.
- B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Sustainable Design Performance Requirements:
 - 1. Wall coverings and adhesives shall comply with the following:
 - a. Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1.
 - b. Adhesives: VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.02 WALL COVERINGS

- A. General: Provide rolls of each type of wall covering from same print run or dye lot.

2.03 VINYL WALL COVERING

- A. Vinyl Wall-Covering Standards: Provide products complying with the following:
 - 1. FS CCC-W-408D and CFFA-W-101-D for Type II, Medium -Duty products.
 - 2. ASTM F 793 for wall coverings that qualify as Category V, Type II, Commercial Serviceability products.
 - 3. Products: As indicated on drawings.
- B. Colors, Textures, and Patterns: As indicated on drawings..
- C. Custom Digital Graphic: As indicated on drawings.

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2.04 ACCESSORIES

SELECT 25 IN THE FOLLOWING PARAGRAPH FOR CLASS A PANELS.

- A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Division 09 Section "Painting " and recommended in writing by wall-covering manufacturer for intended substrate.
- C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 3. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 4. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.
- E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

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- F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.
- G. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

3.03 WALL COVERING INSTALLATION

- A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated except where more stringent requirements apply.
- B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
- D. Install reversing every other strip.
- E. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- F. Match pattern 72 inches above the finish floor.
- G. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
- H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- I. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.
- J. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- K. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

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SECTION 09 72 11 - TACKABLE WALL COVERINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Tackable wall coverings.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittals:
1. Product Data: For adhesives, indicating VOC content.
- C. Shop Drawings: Show location and extent of each wall-covering type. Indicate termination points.
- D. Samples
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall coverings.
- F. Maintenance Data: For wall covering to include in maintenance manuals.

1.03 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Surface-Burning Characteristics: As follows, per ASTM E 84:
a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Sustainable Design Performance Requirements:
1. Adhesives shall comply with the following:
a. Adhesives: VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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2.02 TACKABLE WALL COVERING

- A. Tackable Wall Covering Material:
1. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with integral color throughout with surface-burning characteristics indicated.
 - a. Basis-of-of Design Product: Subject to compliance with requirements, provide products indicated on Drawings, or comparable products by one of the following.
 - 1) Forbo.

2.03 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Division 09 Section "Painting " and recommended in writing by wall-covering manufacturer for intended substrate.
- C. Aluminum Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; of size and shape indicated on Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- B. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 3. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 4. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 5. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- C. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

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- D. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- E. Match pattern 72 inches above the finish floor.
- F. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.
- H. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- I. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

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SECTION 09 81 00 - ACOUSTIC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Acoustic blanket insulation.

1.02 ACTION SUBMITTALS

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

1.03 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.02 ACOUSTIC INSULATION

- A. Acoustic Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Thickness:
 - a. Partitions: As required to fill cavity.
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Partitions:
 - 1) Johns Manville; Unfaced Fiberglass Batts.
 - 2) Owens Corning; Pink Next Gen Sound Attenuation Batts.

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PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness.
- E. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by attaching flanges of insulation to flanges of studs.

END OF SECTION

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SECTION 09 84 33 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes shop-fabricated, sound-absorbing wall panel units tested for acoustical performance.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For sound-absorbing wall units. Include mounting devices and details.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Product certificates.
- E. Maintenance data.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide sound-absorbing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.

2.02 SOUND-ABSORBING WALL UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 - 1. Acoustical Panel Systems (APS, Inc.).
 - 2. Acoustical Solutions, Inc.
 - 3. Armstrong World Industries.
 - 4. AVL Systems, Inc.
 - 5. Benton Brothers Solutions, Inc.
 - 6. Decoustics Limited; a CertainTeed Ceilings company.
 - 7. Essi Acoustical Products.

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8. Golterman & Sabo.
9. Kinetics Noise Control, Inc.
10. Lamvin, Inc.
11. MBI Products Company, Inc.
12. Panel Solutions, Inc.
13. Perdue Acoustics.
14. Pinta Acoustic, Inc.
15. Proudfoot Company, Inc. (The).
16. Sound Concepts Canada, Inc.
17. Sound Management Group LLC.
18. Tectum Inc.
19. Wall Technology, Inc.; an Owens Corning company.
20. Working Walls, Inc.

- B. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of backing material and formed rectangular blades.
1. Basis-of-Design Product: Indicated on Drawings.
 2. Mounting: Back mounted with manufacturer's standard adhesive, secured to substrate.
 3. Core: Manufacturer's standard .
 4. Reveals between Panels: reveals As indicated on Drawings.
 5. Nominal Overall Panel Thickness: As indicated on Drawings.

2.03 MATERIALS

- A. Core Materials: Manufacturer's standard PET felt.
- B. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:

2.04 FABRICATION

- A. General: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install sound-absorbing wall units in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

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- B. Comply with sound-absorbing wall unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align and level fabric pattern and grain among adjacent units.
- D. Clip loose threads; remove pills and extraneous materials.
- E. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

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SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Surface preparation and the application of paint systems on interior and exterior substrates.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 DEFINITIONS

- A. Sheen Levels:
 - 1. Flat: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
 - 2. Eggshell: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
 - 3. Satin: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
 - 4. Semi-Gloss: 35 to 70 units at 60 degrees, according to ASTM D523.
 - 5. Gloss: 70 units and greater at 60 degrees, according to ASTM D523.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for paints and coatings, indicating VOC content.

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1.05 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 3 articles for the paint category indicated.
- B. Source Limitations: Obtain products for each coating system from single source from single manufacturer.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Paints and Coatings:
 - a. VOC content limits for field applications.

2.03 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As indicated on drawings.

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PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Fiber-Cement Board: 12 percent.
 - 3. Masonry (Clay and CMUs): 12 percent.
 - 4. Wood: 15 percent.
 - 5. Gypsum Board: 12 percent.
 - 6. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- B. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- C. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

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- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates:
 - 1. Metal Substrates Galvanized in Accordance with ASTM A 123 and ASTM A 153: Prepare substrates in accordance with ASTM D 6386.
 - 2. Other Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.03 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

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- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.04 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

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- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 INTERIOR PAINTING SCHEDULE

A. Brick Walls as Cafeteria:

1. Full Prime Coat: Primer, acrylic, Dunn-Edwards, EFF-STOP Premium ESPR00.
2. Intermediate Coat: Latex, interior, matching topcoat.
3. Topcoat: Waterborne urethane alkyd, interior/exterior, eggshell, Dunn-Edwards, Aristoshield ASHL30, (Gloss Level 3).

B. Gypsum Board at Cafeteria:

1. Full Prime Coat: Primer, acrylic, Dunn-Edwards, Vinylastic Select, VNSL00.
2. Intermediate Coat: Latex, interior, matching topcoat.
3. Topcoat: Waterborne urethane alkyd, interior/exterior, eggshell, Dunn-Edwards, Aristoshield ASHL30, (Gloss Level 3).

C. Gypsum Board at Serving, Kitchen, Scullery, Laundry Room, Locker Room, and Snack Bar:

1. Full Prime Coat: Primer, acrylic, Dunn-Edwards, Vinylastic Select, VNSL00.
2. Intermediate Coat: Latex, interior, matching topcoat.
3. Topcoat: Waterborne urethane alkyd, interior/exterior, semi-gloss, Dunn-Edwards, Aristoshield ASHL50, (Gloss Level 5).

D. Gypsum Board Ceiling at Restrooms:

1. Spot Prime Coat: Primer, acrylic, Dunn-Edwards, Vinylastic Premium, VNPR00.
2. Intermediate Coat: Latex, interior, matching topcoat.
3. Topcoat: Waterborne urethane alkyd, interior/exterior, semi-gloss, Dunn-Edwards, Aristoshield ASHL50, (Gloss Level 5).

E. Stain and Transparent Lacquer on Wood Slats in Cafeteria:

1. First Coat: Stain, Old Masters.
2. Intermediate Coat: Old Masters, Masters Armor Interior Water-Based Clear Finish, Semi-gloss 72201.
3. Topcoat: Old Masters, Masters Armor Interior Water-Based Clear Finish, Semi-gloss 72201.

F. Hollow Metal Doors and Door Frames:

- a. Ultra-Premium Low Odor / Zero VOC Latex over a Waterborne Alkyd Primer System:
 - 1) Full Prime Coat: Primer, alkyd, anti-corrosive, for metal, Dunn-Edwards, Bloc-Rust Premium BRPR00 Series.
 - 2) Intermediate Coat: Latex, interior, matching topcoat.
 - 3) Topcoat: Waterborne urethane alkyd, interior/exterior, semi-gloss, Dunn-Edwards, Aristoshield ASHL50, (Gloss Level 5).

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END OF SECTION

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SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Dimensional characters.
 2. Panel signs.
 3. Digital poster display.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
1. Include fabrication and installation details and attachments to other work.
 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign.
 4. Provide scaled drawings and signage schedule for each sign indicating materials, lettering layout, and colors.
 5. Provide large-scale drawings and details of custom logo and lettering including 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, spacing, reinforcing, accessories and installation details.
 6. Include font style. 18 point graphical example of alphabet and numerical numbers 0 through 9 of signage font style, upper and lower case letters, punctuation, 18 point scale, and black text on white paper.
 7. Show locations of electrical service connections.
 8. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified. Illustrating full size sample sign with tactile characters, Braille and subsurface text or pictogram to demonstrate fabrication technique and Braille measurements which shall be used on proposed project.
- D. Dimensional character samples: one full-size representative samples of each dimensional character type required, showing letter style, color and material finish and mounting method.
- E. Product Schedule: For signs. Use same designations indicated on Drawings or specified.

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PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" 2022 California Building Code, Chapter 11B-703.
- C. 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.

2.02 DIMENSIONAL CHARACTERS

- A. Cast Characters : Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A.R.K. Ramos.
 - b. ACE Sign Systems, Inc.
 - c. ASI Sign Systems, Inc.
 - d. Cosco.
 - e. Gemini Signage; Gemini, Inc.
 - f. Matthews International Corporation; Bronze Division.
 - g. Metal Arts.
 - h. Metallic Arts.
 - i. Southwell Company (The).
 - 2. Character Material: Cast aluminum.
 - 3. Character Height: As indicated on Drawings.
 - 4. Finishes:
 - a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as indicated by manufacturer's designation .
 - b. Overcoat: Manufacturer's standard baked-on clear coating.
 - 5. Mounting: Manufacturer's standard, recommended mounting method.

2.03 PANEL SIGNS

- A. ADA Tactile and Braille Panel Signs: Signs with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Basis-of-Design Product: Gravotac; GTAC-INT.
 - 2. Sign Material: Laminated sandblasted polymer.

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3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Square.
4. ADA Tactile: Manufacturer's standard process for producing copy complying with CBC and ADA Accessibility Guidelines. Text shall be accompanied by California Grade 2 Braille. Produce precisely formed characters with square cut edges free from burrs and cut marks, permanently fused to substrate.
 - a. Raised-Copy Thickness: Not less than 1/32 inch.
5. Frame: Entire perimeter.
 - a. Material: Aluminum.
 - b. Profile: Square.
 - c. Corner Condition in Elevation: Square.
 - d. Finish and Color: Painted, matte black color.
6. Unframed Signs: Sized as required for text or room number.
7. Mounting: Manufacturer's standard method for substrates indicated with unless indicated otherwise.

- B. Non-Tactile Signs: Cast Acrylic Plastic Sheet; ASTM D4802 Category A-1, 1/4 inch overall thickness, laminated acrylic plastic sheets, Sub-surface Screened process graphics and symbols, exterior-grade at exterior locations, 3/8 inch radius corners, eased edge, drilled holes for countersunk screws, polished edges.

1. Basis-of-Design Manufacturer: Gravotac.
2. Frame: Entire perimeter.
 - a. Material: Aluminum.
 - b. Profile: Square.
 - c. Corner Condition in Elevation: Square.
 - d. Finish and Color: Painted, matte black color.
3. Unframed Signs: Sized as required for text or room number.
4. Apply UV inhibitor overcoat for exterior signs.
5. Mounting: Manufacturer's standard method for substrates indicated with unless indicated otherwise.

2.04 DIGITAL POSTER DISPLAYS

- A. LED Digital Poster Display:
1. Product: Provide the following:
 - a. Huake; Intelligent HD Indoor LED Poster Model EP1.8S; Bottom Base style.
 2. Pixel Pitch: 1.8 mm.
 3. Display Size: 480 mm by 1920 mm by 50 mm.
 4. Resolution: 344 by 774 dots.
 5. Brightness: 800 nits.
 6. Contrast: 3000:1.
 7. Refresh Rate: 3840 Hz.
 8. IP Grade: IP30.
 9. Life Span: 50,000 hours.
 10. Communications: Wifi, LAN, USB drive.

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2.05 SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Zinc Sheet: ASTM B69, alloy and temper recommended by sign manufacturer for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D4802, Type UVF (UV filtering).
- D. Polycarbonate Sheet: Coated, mar-resistant, UV-stabilized polycarbonate, with coating on both sides.
- E. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

2.06 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Screws, flat head, pin-in-head torx screws for vandal-proof and clear silicone adhesive meeting ASTM C834. Double face adhesive tape not permitted.
- B. Adhesive: As recommended by sign manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions & the requirement in CBC 11B-703.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.

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3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Accessible Signage: Install in locations on walls as indicated on Drawings according to the accessibility standard & CBC.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION

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SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Corner guards.
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
 - 2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

1.03 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for adhesives, indicating VOC content.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.02 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:

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1. Adhesives:
 - a. VOC content limits for field applications.

2.03 CORNER GUARDS

- A. Surface-Mounted, Transparent-Plastic Corner Guards: Fabricated as one piece from clear polycarbonate plastic sheet; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
 1. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated in drawings.
 2. Wing Size: As indicated on drawings.
 3. Mounting: Countersunk screws through factory-drilled mounting holes.
- B. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
 1. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated in drawings.
 2. Material: Stainless-steel sheet, Type 304.
 - a. Thickness: Minimum 0.0500 inch.
 - b. Finish: Directional satin, No. 4.
 3. Wing Size: As indicated on drawings.
 4. Corner Radius: 1/8 inch.
 5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

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3.03 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

3.04 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

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SECTION 10 28 00 - TOILET ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Washroom accessories.
 2. Shower room accessories.
 3. Hand dryers.
 4. Custodial accessories.

1.02 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
1. Identify locations using room designations indicated.
 2. Identify accessories using designations indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.06 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, visible silver spoilage defects.
 2. Warranty Period: 10 years from date of Substantial Completion.

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- B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
 - 2. Shower Seats: Installed units are able to resist 360 lbf applied in any direction and at any point.

2.02 WASHROOM ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated or comparable products by one of the following:
 - 1. AJW Architectural Products.
 - 2. ASI-American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. Brey-Krause Manufacturing Co.
 - 6. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - 7. Tubular Specialties Manufacturing, Inc.
- B. Toilet Tissue (Roll) Dispenser:
 - 1. Basis-of-Design Product: B-2888, Surface mount and B-3888 Semi-recessed.
 - 2. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- C. Paper Towel (Folded) Dispenser:
 - 1. Basis-of-Design Product: #5510282 Tork Matic.
- D. Soap Dispenser:
 - 1. Basis-of-Design Product: #91628, Black Proline Curve Dispenser Green Tip.
- E. Grab Bar:
 - 1. Basis-of-Design Product: Bobrick; B-6808.
 - 2. Material: Stainless steel, 0.05 inch thick.
 - 3. Configuration and Length: As indicated on Drawings.

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- F. Sanitary-Napkin and Tampon Vendor:
 - 1. Basis-of-Design Product: Bobrick; B-3706.
 - 2. Mounting: Semirecessed.
 - 3. Exposed Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - 4. Lockset: Tumbler type with separate lock and key for coin box.

- G. Sanitary-Napkin Disposal Unit:
 - 1. Basis-of-Design Product: Bobrick; B-270.
 - 2. Mounting: Surface mounted.
 - 3. Receptacle: Removable.
 - 4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

- H. Seat-Cover Dispenser:
 - 1. Basis-of-Design Product: Bobrick; B-221.
 - 2. Mounting: Surface mounted.
 - 3. Exposed Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - 4. Lockset: Tumbler type.

- I. Mirror Unit:
 - 1. Basis-of-Design Product: Bobrick; B-290.
 - 2. Frame: Stainless steel angle, 0.05 inch thick .
 - a. Corners: Manufacturer's standard.
 - 3. Size: As indicated on Drawings.

2.03 SHOWER ROOM ACCESSORIES

- A. Shower Curtain Rod:
 - 1. Basis-of-Design Product: Bobrick B-6107x72.

- B. Shower Curtain:
 - 1. Basis-of-Design Product: Bobrick 204-3.

- C. Folding Shower Seat:
 - 1. Basis-of-Design Product: Bobrick B-5192.

2.04 HAND DRYERS

- A. Warm-Air Dryer:
 - 1. Basis-of-Design Product: #XL-W, XLERATOR.
 - 2. Description: Standard-speed, warm-air hand dryer.
 - 3. Mounting: Recessed.
 - a. Protrusion Limit: Installed unit protrudes maximum 4 inches from wall surface.
 - 4. Operation: Infrared-sensor activated with timed power cut-off switch.

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- a. Automatic Shutoff: At 40 seconds.
- 5. Cover Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- 6. Electrical Requirements: 110-120V - 11.3-12.2 amps, 1240-1450 Watts, 50/60 HZ.

2.05 CUSTODIAL ACCESSORIES

- A. Custodial Mop and Broom Holder:
 - 1. Basis-of-Design Product: Bobrick; B-239.
 - 2. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.06 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.
- C. Master key all accessories.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.
- D. Contractor shall install all necessary blocking, backing, and recessed openings for all toilet accessories.
- E. Hand Dryers: extend power to location of hand dryer and provide necessary backbox for connection. provide in-wall blocking for unit support

3.02 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

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- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION

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SECTION 10 51 13 - METAL LOCKERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Welded lockers.
 - 2. Locker benches.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For metal lockers.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include locker identification system and numbering sequence.
- C. Samples: For each color specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.05 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Warranty Period for Welded Metal Lockers: Lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and California Building Code, Chapter 11.

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2.02 WELDED LOCKERS

- 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. DeBourgh Mfg. Co.
- B. Doors: One piece; fabricated from 0.075-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
 - 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
- C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
 - 1. Tops, Bottoms, and Sides: 0.060-inch nominal thickness.
 - 2. Backs: 0.048-inch nominal thickness.
 - 3. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.
- D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
- E. Hinges:
 - 1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches high. Provide no fewer than three hinges for each door more than 42 inches high.
- F. Door Handle and Latch: Latch control designed for use with either built-in combination locks or padlocks; positive automatic latching, chromium plated; pry and vandal resistant.
 - 1. Latch Hooks: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 - 2. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- G. Locks: Combination padlocks or Built-in combination locks as selected by Owner.
- H. Continuous Zee Base: Fabricated from, 0.075-inch nominal-thickness steel sheet.

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1. Height: 6 inches.
 - I. Continuous Sloping Tops: Fabricated from 0.048-inch nominal-thickness steel sheet, with a pitch of approximately 25 degrees.
 - J. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.
 - K. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - L. Materials:
 1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
 - M. Finish: Baked enamel or powder coat.
 1. Color: As selected by Architect from manufacturer's full range.
- 2.03 LOCKER BENCHES
- A. Provide bench units with overall assembly height of 17-1/2 inches.
 - B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.
 1. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.
 - C. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors.
- 2.04 FABRICATION
- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 - B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
 - C. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.
 - D. Accessible Lockers: Fabricate as follows:
 1. Locate bottom shelf no lower than 15 inches above the floor.

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2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.
- E. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.
- F. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
- G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- H. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install lockers level, plumb, and true; shim as required, using concealed shims.
 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 48 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 2. Anchor single rows of metal lockers to walls near top of lockers and to floor.
 3. Anchor back-to-back metal lockers to floor.
- B. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.
- C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 1. Attach filler panels with concealed fasteners.
 2. Attach sloping-top units to metal lockers, with closures at exposed ends.
 3. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.
- D. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart.

END OF SECTION

HMC Architects
3186071000

METAL LOCKERS
10 51 13 - 4

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**SECTION 11 40 00
FOODSERVICE EQUIPMENT**

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This section includes furnishing all labor and material required to provide and deliver all Food Service Equipment herein specified into the building, uncrate, assemble, set-in-place, level and completely install, exclusive of final utility connections.
- B. Furnish all material and labor required to completely provide, deliver and install all Food Service Equipment as specified herein and as shown on the drawings. This work shall be in strict accordance with the plans and specifications with all dimensions verified in the field prior to any fabrication.
 - 1. Coordinate the Food Service Equipment work with the respective trades performing preparatory work for the installation of the Food Service Equipment.
 - 2. Comply with all Federal, State and Municipal regulations which bear on the execution of this project. Food Service aisles shall be a minimum of 36" wide and tray slides shall be mounted at 34" maximum above the finished floor.
- C. WORK INCLUDES:
 - 1. Materials shown on the Food Service Equipment Schedule.
 - 2. Piping, valves, and plumbing accessories that are integral within the equipment.
 - 3. Furnishing control devices such as solenoid valves that are not integral with the equipment, for installation by Mechanical Division 15 and/or Electrical Division 16.
 - 4. Wiring, wiring devices, controls and mechanical accessories that are integral in the equipment.
 - 5. Ventilating ducts, flues, controls and mechanical accessories that are integral in the equipment.
 - 6. Anchors, fasteners, fillers and sealants for mounting equipment securely in place.

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7. Cooperation with all other contractors on the job including the furnishing of information in the form of drawings, wiring diagrams and other data.
8. Touch-up painting after the installation of the Food Service Equipment.

D. RELATED SECTIONS INCLUDE THE FOLLOWING:

1. Mechanical
2. Electrical

1.03 QUALITY ASSURANCE

A. QUALIFICATIONS:

1. Installer: Regularly engaged in providing Food Service Equipment from manufacturers of this type of equipment a minimum of five (5) years with at least five (5) installations of this size and type that are at least each three (3) years old.

B. STANDARD OF MANUFACTURE

1. Food Service Equipment that is specified as "custom" having no manufacture name or model number shall be manufactured by a Food Service Equipment Fabricator with at least five (5) years of experience with engineering, design and fabrication of Food Service Equipment. The manufacture shall be subject to the review of the Architect and/or Consultant and shall be approved by the National Sanitation Foundation. All fabricated equipment shall be constructed in strict compliance with the latest standards of the National Sanitation Foundation and shall bear the mark of the National Sanitation Foundation in full compliance with all applicable codes and ordinances.
2. All electrically heated or operated equipment shall bear the seal of approval of the Under Writers Laboratories and shall comply with the National Electrical Code and all local Codes and Ordinances.
3. All Food Service Equipment that is specified as "buy-out" having a specific manufacture name and model number shall comply with the latest editions of the National Sanitation Foundation.
4. All gas-heated or operated equipment shall bear the seal of approval of the American Gas Association (AGA).
5. All steam heated, or operated equipment shall conform to the standard of the American Society of Mechanical Engineers (ASME) and shall be ASME approved.

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6. Food shields and sneeze guards shall meet all the requirements of National Sanitation Foundation (NSF) Standard 2.

1.04 SUBMITTALS

A. SHOP DRAWINGS / EQUIPMENT BROCHURES

1. No ordering or fabrication of equipment shall take place until such time as the Equipment Brochures and Shop Drawings have been reviewed in writing by the Architect and/or Consultant. Receipt of this review shall not relieve the Contractor from the responsibility of verifying all quantities and related dimensions, maintaining the specified quality of equipment, and verifying conditions of the job site.
2. Equipment Brochures; within twenty (20) calendar days after award of the contract, submittals in the form of PDF containing Manufacturers specification sheets, dimensioned drawings and/or other pertinent data describing all items of standard manufacture shall be submitted for review by the Architect and/or Consultant. Sheets with the notation "Fabricated Item" and name of the fabricated item, as well as any required mechanical, plumbing or electrical requirements shall be inserted between the Manufacturer's specification sheets describing the "buy-out" equipment; thus, giving a complete Brochure with all times accounted for. These Brochures shall have hard white covers with clear transparent overlays and locking rings. The name of the Contractor, Architect, Consultant and project clearly identified in large readable type. Failure to provide Brochures in the manner as described above will be cause for rejection of said brochures.
3. Rough-in and Equipment Location Drawings; within thirty (30) calendar days after award of the contract, submittals in the form of PDF, complete rough-in and details, electrical and plumbing services with both vertical and horizontal dimensions, from column center-lines or exterior walls for location said connection points and rough-in locations shall be submitted for review by the Architect and/or Consultant. Equipment location plans shall be drawn to scale of not less than 1/4" = 1'-0" and include a schedule of equipment clearly identifying all items. Minimum drawings size shall be 24"x 36".
4. Shop Drawings; within thirty (30) calendar days after award of the contract, submittals in the form of PDF of shop fabrication drawings shall be submitted for review by the Architect and/or Consultant. Plans shall be drawn to scale of not less than 1/2"=1'-0". Additional plan views, elevations and sections at 3/4"=1'-0" shall be supplied of all counters and tables with complete dimensions. All shop practices regarding joints, gussets, bracing, tie-downs, supports, etc. shall be clearly defined as well as gauges and quality of metals and brands and model numbers of all miscellaneous fittings, plumbing and electrical trim. The drawings shall also show locations of blocking (supplied under another sections) for all wall and ceiling mounted Food Service Equipment. Minimum drawings size shall be 24"x36".

B. SAMPLES

AMD FOODSERVICE DESIGN
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1. Provide all samples if specification requested.

C. SUBSTITUTIONS:

1. Manufacturer's listed in this section are used as standards for quality. All substitutions shall be approved by the Architect and/or Consultant prior to installation.
2. Refer to Division 1 - General Requirements for procedures governing substitutions.
3. Only one substitution for each item will be considered.
4. Installation of any qualified substituted equipment is the Food Service Equipment Contractor's responsibility. Including any mechanical, electrical, structural changes required for the installation of qualified substitution shall be without additional cost to the Owner.

D. DEFERRED APPROVAL ITEMS:

1. For the items identified on the Equipment List as (Deferred Approval Item), the following submittal requirements shall be provided:
 - a. Product data.
 - b. Manufacturer's recommended methods of installation coordinated with actual field conditions for anchorage to actual substrate conditions.
 - c. Shop Drawings: Indicate types, sections, gages, materials, completely dimensioned layouts and configurations, hardware, fasteners, operators and shop finishes and other required coatings. Provide calculations for all required connections.
 - d. Structural calculations, detail drawings, and all additional necessary drawings and specifications for a deferred approval shall be signed by a Structural Engineer licensed in the State of California.
 - e. Provide a copy of the Installer's Certification and a copy of the Manufacturer's written certification criteria. Provide list of a minimum of (5) five jobs installed by Installation Company with contact phone numbers of both the project's General Contractor and Owner.

1.05 DISCREPANCIES

- A. In the event of discrepancies within the Contract Documents, the Architect and/or Consultant shall be so notified within sufficient time prior to bid opening, ten (10) days to allow issuance of an addendum.

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- B. In the event where time does not permit notification or clarification of discrepancies prior to the bid opening, the following shall apply: The drawings and drawing schedules shall govern in matters of quantity; the specifications in matter of quality. In the event of conflict within drawings involving quantities, or within the specifications involving quality, the greater quantity and high quality shall apply. Such discrepancies shall be noted and clarified in the contractors bid. No additional allowances will be made because of errors, ambiguities or omissions that should have been discovered during the preparation of the bid.

1.06 RESPONSIBILITY

- A. The work as specified in this division shall include; assuring that all required submittals conform to the intent and meaning of the documents, conditions at the Job Site, and all Local Codes and ordinances.
- B. Visit the Job Site to field check actual wall dimensions and utility rough-ins. Be responsible for furnishing, fabricating, and installing the equipment in accordance with the available space and utility services as they exist on the Job Site.
- C. Check all door openings, passageways, elevators, etc., to verify that the equipment can be transported to its proper location within the building. If necessary, check the possibility with the General Contractor of holding wall erection, placement of doorjambs, window, etc. for the purpose of moving equipment to its proper location.
- D. Notify the Architect and/or Consultant of any discrepancies between the plans and specification prior to fabrication of any equipment, to actual condition on the job.
- E. If any special hoisting equipment and operators are required, include cost as part of the bid for this work.

1.07 DELIVERY AND STORAGE

- A. All equipment specified herein shall be delivered to the Job Site; received and handled by the Contractor or his authorized agent. The Owner shall in no way be expected to store or handle any such equipment.
- B. All equipment shall be delivered in such a manner as to protect it against dirt, water, chemical or mechanical injury.
- C. Throughout the progress of the work, the Contractor shall keep the working area free of debris of all types resulting from his work.
- D. All packing material shall be removed from the project location by the Contractor.

1.08 COORDINATION

AMD FOODSERVICE DESIGN
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- A. Coordinate work with mechanical, electrical, plumbing, interiors and other trades whose work is in conjunction with equipment specified herein.

1.09 MEASUREMENTS

- A. Verify all dimensions shown on the drawings by taking field measurements at the Job Site prior to fabrication of equipment or ordering equipment. Proper fit and attachment of all parts is required and is the sole responsibility of the Food Service Contractor. If necessary, all equipment shall be fabricated so that it may be handled through finished door openings.

1.10 PRODUCT REQUIREMENTS

- A. Refer to Section 01 60 00.

1.11 GUARANTEE / WARRANTY

- A. All work shall be guaranteed by the Foodservice Equipment Contractor against all defects for a term of one (1) year from the date of notice of completion. This guarantee shall cover replacement of defective material at the Foodservice Equipment Contractor expense, including transportation and labor. This guarantee will not cover any cost for replacement of parts or work made necessary by carelessness or misuse of the equipment by others.
- B. The Food Service Equipment Contractor shall provide at his own expense the installation, start-up and service for one (1) year from the date of recording the notice of completion of the project; the replacement of all Condensing Units and other Refrigeration Devices supplied under this contract. In addition to this one (1) year free service, the Condensing Units shall have a five (5) year Compressor Warranty; said Warranty commencing at the date of completion.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Metal for construction purposes, where entirely concealed, shall be steel of wrought iron sections galvanized by the hot-drip process after fabrication. Bolts, screws, rivets, and similar attachments to this galvanized work shall be galvanized or brass. Exposed screw and rivet work shall be finished to match adjacent surfaces, flush and buffed smooth. Finished work shall be free of tool or construction marks, dents, or other imperfections; and at the completion of the work, all metal shall be gone over with a portable machine and buffed and dressed to perfect surfaces.
- B. All materials shall be new and of first grade. All gauges specified herein shall be minimum and shall be established after polishing. They shall refer to:

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1. U.S. Standard Gauge for sheets and plates.
 2. Stainless steel shall be manufactured by one of the following: Allegheny Ludlum Steel Corporation, American Rolling Mills, U.S. Steel Corporation.
- C. The Contractor will be required to furnish a certified copy of the Mill Analysis of materials to the Architect and/or Consultant.
- D. Stainless steel sheets shall conform to ASTM A240, Type 304 Condition A, 18-8 having a No. 4 finish. No.2B finish shall be acceptable on surfaces of equipment not exposed to view. All sheets shall be uniform throughout in color, finish and appearance.
- E. Stainless steel tubing and pipe shall be Type 304, 18-8, having a No. 4 finish, and shall conform to either ASTM A213 if seamless or ASTM A249 if welded.
- F. Galvanized steel shall be approved grade of copper-bearing steel sheets with a minimum copper content of 20%. All sheets to be commercial quality, stretcher leveled, bonderized and re-rolled to insure smooth surface. Galvanized steel shall not be allowed in the construction and fabrication of any "Fabricated Assembly" items.
- G. All millwork materials shall be free from defect impairing strength, durability, or appearance; straight and free from warpage; and the best grade for their particular function. All wood shall be well seasoned and kiln dried and shall have an average moisture content of 8%, a maximum of 10%, and a minimum of 5%.
- H. Plywood and other woodwork of treatable species, where required by code, shall be fire-retardant treated to result in a flame spread rating of 25 or less with no evidence of significant progressive combustion when tested for 30 minutes duration under ASTM E-84 and shall bear the testing laboratory mark on the surface to be concealed.
- I. Concealed softwood or hardwood lumber shall be of Poplar, Douglas Fir, Basswood, Red Oak, Birch, Maple, Beech or other stable wood and shall be select or better grade, unselected for color and grain, surfaced four sides, square-edged, and straight. Basswood may be used where fire-retardant treated materials are required.
- J. Face veneers shall be matched for color and grain to produce balance and continuity of character. Mineral streaks and other discolorations, wormholes, ruptured grain, loose texture, doze or shake will not be permitted. Face veneer leaves on each surface shall be full-length, book matched, center matched, and sequence matched. Surfaces shall be sequenced, and Blueprint matched. Veneers not otherwise indicated shall be plain sliced. Backing veneers for concealed surfaces shall be of a species and thickness to balance the pull of the face veneers.
- K. Hardwood plywood for painted surfaces shall conform to U.S. Product Standard PS -51-71, Type I, and shall have sound Birch, Maple or other approved close grain hardwood faces suitable for paint finish.

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- L. Plastic laminate surfaces shall be laminated with thermosetting decorative sheets in the color, pattern and style as selected by the Architect. Horizontal surfaces shall be laminated with sheets conforming to Federal Specifications L-P-508F, Style D, Type I (general purpose), Grade HP, Class I, 1/16" thick, satin finish with rough sanded backs. Vertical surfaces shall be laminated with sheets conforming to Federal Specification L-P-598F, Style D, Type II (vertical surface), Grade HP, Class I, conforming, satin finish, 1/32" thick or heavier. Balance sheets for backs in concealed locations shall be .020" thick laminate backing sheets conforming to Federal Specification L-P-00508E, Style ND, Type V (backing sheet), Grade HP.
- M. Adhesive for application of plastic laminate to wood surfaces of counter tops shall be Phonetic, Resorcinol or Melamine adhesive conforming to Federal Specification MMM-A-181C and producing a waterproof bond. Adhesive for applying plastic laminate to vertical surfaces shall be either a waterproof type or a water-resistant type such as a Modified Urea Formaldehyde Resin liquid glue conforming to Federal Specification MMM-A-188C. Contact adhesive will not be acceptable.
- N. Plate glass shall be 1/2" thick safety glass with polished edges.
- O. Sealant shall be equal to that manufactured by General Electric. Silicone construction 1200 sealant; in either clear or approved color to match surrounding surfaces.
- P. Sound deadening material shall be equal to that manufactured by H.W. Mortell Co., Kankakee, Illinois, and shall be sprayed by use of a mechanical device to a thickness of not less than 1/8" thick.

2.02 FINISHES

- A. Paint and coatings shall be of an NSF approved type suitable for use in conjunction with Food Service Equipment. Such paint or coating shall be durable, non-toxic, non-dusting, non-flaking and mildew resistant, shall comply with all governing regulations and shall be applied in accordance with the recommendations of the manufacturer.
- B. All exterior, galvanized parts, exposed members of framework where specified to be painted shall be cleaned, properly primed with rust inhibiting primer, degreased, and finished with two (2) coats of epoxy-based grey Hammertone paint, unless otherwise specified.
- C. Stainless steel, where exposed, shall be polished to a #4 commercial finish. Where unexposed, finish shall be #2B. The grain of polishing shall run in the same direction wherever possible. Where surfaces are disturbed by the fabricating process, such surfaces shall be refinished to match adjacent undisturbed surfaces.

2.03 SHOP FABRICATED EQUIPMENT CONSTRUCTION

- A. Leg stands for open base tables or dish tables shall be constructed of 1-5/8" dia. 16-gauge stainless steel tubing, with stringer and cross braces of the same material. Joints

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between legs and cross braces shall be welded and ground smooth. Flattened ends on tube stretchers are not permitted. Mechanical fittings are also not permitted.

1. Stainless Steel Leg Sockets: Component Hardware Group, Inc. model A18-0206, or accepted equal; weld to underside of countertop framing or at bottom of enclosed cabinet unit and fastened with flush set screw locking device.
 2. Sanitary Type Stainless Adjustable Foot: Component Hardware Group, Inc. model A10-0851, or accepted equal
- B. Tabletops shall be 14-gauge stainless steel unless otherwise noted, with all shop seams and corners welded, ground smooth and polished. Tops of closed base fixtures shall be reinforced on the underside with a framework of 1-1/2" angles or 16-gauge stainless steel hat section; and on open pipe frames with a 4" channel at each pair of legs. The leg sockets shall be welded to this channel. The channel in turn stud welded to the top. Tops shall be reinforced so that there will be any noticeable deflection. Unless otherwise shown on the detail drawings, metal tops shall be turned down 2", and back at 15-degree angle, with 1-1/8" turn-under, except where adjacent to walls or other pieces of equipment. The wall side shall be turned up 10" and back 2" at a 45-degree angle. Ends of this splash are to be closed. Free corner of tops shall be spherical. All tops shall have 1/8" of sound-deadening material applied to the underside by use of spray equipment in an oven, smooth application for ease in cleaning.
- C. Enclosed bases or cabinet bodies shall be of the material and gauge hereinafter specified. They shall be enclosed on the ends and sides as required. The bases shall be reinforced at the top with a framework of 1-1/2" x 1-1/2" x 1/8" stainless steel angles fully welded to the base with the stainless-steel angles 36" on center (maximum), with all corners of said framework mitered and fully welded. All vertical joints of the bases shall be fully welded, ground and polished. All free corners of enclosed bases or cabinet bodies and all corners against walls and other fixtures shall be square. In the case of fixtures fitting against or between walls, the bodies shall be set in 1" from the wall line, but the tops shall be extended back to the wall line to permit adjustment to wall irregularities. A flush fitting vertical trim strip (extension of the vertical end mullion without vertical seam of the same material as the body shall be provided at each end of the body and shall extend 1" to the wall line). These fixtures shall be constructed to set on bases or legs as hereinafter specified and shall be set in mastic in a vermin-proof manner.
- D. Shelves, mullions and aprons shall be fabricated flush with the cabinet body, welded, ground, and polished. Butt joints are not acceptable.
- E. Drawers, to be furnished with stainless steel flush pull, Component Hardware Group Inc., model number P63-1012 or equal installed into the 18-gauge double-pan drawer front panel.
1. Stainless steel locks, Component Hardware Group, Inc., model number P30-4781 or equal for each drawer. All drawers are to be keyed alike.

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2. Stainless Steel full extension slides, Component Hardware Group, Inc., model no S52-0024 or equal. Provide two (2) per drawer. Slides to be installed so drawer will roll closed when released.
 3. Stainless steel removable drawer pan, Component Hardware Group, Inc., model number, S81-1520 or equal one (1) per drawer set loosely in a channel frame so it can be easily lifted out for cleaning. This supporting frame shall be welded stainless steel channel.
 4. Drawer face panel to be constructed of 18-gauge stainless steel double pan construction. (Single metal thickness drawer faces are not be expectable.)
- F. Hinged doors in base cabinets shall be of double pan construction, insulated and constructed of 18-gauge stainless steel. Doors shall have wire type pull Component Hardware Group Inc., model number P46-1010 or equal installed as shown in elevations. Door pulls to be NSF and ADA compliant.
- G. Interior shelves shall be solid, non-removable 16-gauge stainless steel, with ends and backs provided with a 1-1/2" high turn-up against the body of the fixture and welded to the same. Front edge is to be turned down 1-1/2" and under 1/2", at the bottom shelf, beyond the edge of the base to prevent sagging and vermin collection.
- H. Under shelves on open tables shall be constructed of 16-gauge stainless steel, flanged down 90 degrees 1/2". The corners shall be welded to the legs. Under shelves shall be 10" from the floor. Backs shall be turned up 2".
- I. Elevated shelves shall be constructed of 16-gauge stainless steel with edges turned down in a square edge, and back 1/8"; except where shelves are adjacent to walls or other fixtures, where they shall be turned up 2". Corners shall be spherical, mounted on 14-gauge stainless steel support brackets.
- J. Sinks and drain boards shall be constructed of 14-gauge stainless steel. The working edge of the sink shall be provided with 5/8" radius sanitary rolled edge in one piece with rounded corners. The drain boards shall be made as an integral part of the sink; all vertical and horizontal corners shall be rounded with 5/8" radius; and the working front edges shall be maintained at one level, taking up the pitch of the drain boards by dropping the sink to allow for same. Depth of sink bowl shall be determined from the top bowl. Sinks shall be provided with back and end splashes with top edge flanged back 2-1/4" at 45-degree angle and attached to the building wall with "zee" clips. Splash back of sinks and drain boards shall be grained in the same direction. Suitable openings shall be cut for hot and cold-water supplies and waste outlets. All surface plumbing trim as called for on the drawings and herein specified shall be provided. Bottom of each sink bowl with center drain connection shall be fitted with a 2" lever type action waste valve mounted into the sink and made absolutely watertight. Sink bowls and drain boards shall have 1/8" of sound-deadening material underneath, spray-applied.
- K. Rivets, bolts and screws shall not be permitted in any exposed location.

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- L. All welding shall be of the heliarc method with welding rod of the same composition as the parts welded. Welds shall be complete, strong, and ductile with excess metal ground off and joints finished smooth to match adjoining surfaces. Welds shall be free of mechanical imperfections and shall be continuously welded so that the fixture shall appear as one-piece construction. Butt welds made by spot solder and finished by grinding are not acceptable.
- M. All exposed joints shall be ground flush with adjoining material and finished to harmonize therein. Whenever material has been sunk or depressed by welding operation, such depressions shall be suitably hammered and peened flush with the adjoining surface and, if necessary, again ground to eliminate low spots. In all cases, the grain of rough grinding shall be removed by successive fine polishing operations.
- N. All exposed welded joints in stainless steel construction shall be suitably coated with an approved metallic-based paint.
- O. After galvanized steel members have been welded, all welds and areas where galvanizing has been damaged shall have a zinc dust coating applied.
- P. Seams shall be continuous welds flush and ground smooth.
 - 1. Field Joints: Flush welded, ground smooth and polished on the job, solder or rivets not allowed.
 - 2. Counter Tops: Field joints in stainless steel counter tops and drain boards butt welded with welds ground flush and smooth and polished to match original finish.
 - 3. Pass windows: Provide a complete all welded seamless counter from inside area to the outside ledge at each pass window location. Mechanical joints, butt joints or lap joints will not be accepted.

2.04 ELECTRICAL REQUIREMENTS

- A. Standard UL listed materials, devices and components shall be selected and installed in accordance with NEMA Standards and Recommendations and as required for safe and efficient use and operation of the Food Service Equipment without objectionable noise, vibration, and sanitation problems.
- B. Motors up to and including ½ HP are to be wired for 120-volt, single phase. Fixtures totaling more than 1000 watts are to be wired for 208-volt, single-phase. Fixtures having multiple number of heating elements, can be wired for three-phase with the load balanced as equally as possible within the fixture.
- C. Heating elements having a connected load of up to and including 1000 watts are to be wired for 120-volt, single-phase. Fixtures totaling more than 1000 watts are to be wired

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for 208-volt, single-phase. Fixtures having multiple number of heating elements can be wired for three-phase with the load balanced as equally as possible within the fixture.

D. Equipment where applicable shall be furnished with three-wire cord and plug.

2.05 PLUMBING TRIM, SINKS

A. All vegetable and pot washing sinks, or other 14" deep sinks shall have Fisher Mfg. Co. Model 22209 series (2" drain size) quick opening drain. Fisher Mfg. Co. Model 60100 splash mounted faucet shall be mounted over each partition as shown on the drawings.

B. All cook sinks, pantry sinks or other 10" or 12" deep sinks shall have Fisher Mfg. Co. Model 22209 series (2" drain size or as shown on the drawings) quick opening drain. Fisher Mfg. Co. Model 57649 faucets mounted as shown on the drawings.

C. All Fisher Mfg., Co. faucets to be furnished as stainless steel to comply with AD1953 Standards and conform to NSF 61 Standard 9.

D. Provide gas pressure regulators for installation by the Plumbing Contractor.

E. FIRE SUPPRESSION GAS SHUT/OFF VALVE: Gas valve to be furnished by the Foodservice Equipment Contractor and furnished to the Plumbing Contractor for installation. Foodservice Equipment Contractor is to verify with Plumbing Division for gas line size. Valve to be located in an accessible location and if necessary, with access panel.

2.06 HARDWARE

A. Elevated shelf brackets shall be as shown on the Drawings.

B. Drawer and door handles shall be as shown on the Drawings.

C. Hinges for all metal doors shall be Klein Hardware Co. 7870 series, finished in satin chrome.

2.07 REFRIGERATION

A. Each refrigeration items specification is written to provide minimum specifications and scope of work. Refrigeration equipment shall be designed and installed to maintain the following general temperature unless otherwise specified.

a.	Walk-In Refrigerators	1.7°C / 35°F
b.	Walk-In Freezers	-23.2°C / -10°F
c.	Reach-In Refrigerators	1.7°C / 35°F
d.	Reach-In Freezers	-23.2°C / -10°F
e.	Undercounter Refrigerators	1.7°C / 35°F
f.	Undercounter Freezers	-23.2°C / -10°F

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g. Cold Pan 5°C / 41°F

PART 3 - INSTALLATION

3.01 POSITIONING OF EQUIPMENT

- A. Installation procedure, details and scheduling shall be so arranged that the work of other contractors may progress without unnecessary delay, interference or damage.
- B. The Contractor shall do all fitting, joining, fastening, scribing, caulking and adjusting necessary to install any fixed item of equipment in its designated location; and shall locate and/or store portable, non-fixed items as directed by the Architect and/or Consultant with due regard for the security and protection from damage of the items involved.

3.02 WORKMANSHIP

- A. Commencement of work shall constitute agreement with and acceptance of all conditions as found.
- B. Equipment shall be installed as shown on the plans. Where abutting, curved or irregularly shaped angles or projecting corners of walls occur, equipment shall be made to conform. Where several pieces of equipment are to be assembled in a group, the group shall be complete as whole, with all necessary filler or connecting pieces as may be required to make a complete, sanitary and vermin-proof group.
- C. Welded parts shall be non-porous and free of imperfections. Welds on galvanized metal shall be ground smooth, sandblasted and sprayed with molten zinc or 1200 degrees F to a thickness of .004". Tinning of welds will not be acceptable. Welds of stainless steel shall be ground and polished to the original finish and all grained in the same direction.
- D. All fixtures, unless made of stainless steel, shall be finished in sprayed lacquer in color as chosen by the architect; or if specifically stated, in "plastic laminate"; in pattern and/or color as selected by the Architect.

3.03 POST INSTALLATION PROCEDURES

- A. Prior to being offered for final acceptance, all equipment shall be thoroughly cleaned. This shall include removal of all stains, paint spots, protective wrapping and coatings, tapes, grease, oil, plaster, dust, polishing compounds, etc. and cleaning of floors in food service areas (broom clean) and signed off by the General Contractor with a copy to the Architect and/or Consultant.
- B. After installation at least ten (10) days prior to offering for acceptance, all equipment shall undergo a "Start-up" procedure by a Factory Authorized Service Dealer. Equipment is to be inspected, tested, calibrated and adjusted for normal operation conditions. If

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inspection or testing indicated defects, such defects shall be corrected, and the inspection and test repeated to insure a perfect operation of all equipment, prior to final acceptance and for a period ninety (90) days after final acceptance.

- C. Upon completion of the project, the Contractor shall furnish the Owner two (2) sets of Dimensional Prints, Data Sheets, Spare Parts Lists and Operating Manuals for each piece of mechanical equipment; each set shall be neatly bound in a loose-leaf binder, each set shall be complete with and Index of Equipment and with a complete List of Service Contracts with said agencies to perform these services. In addition to this list: The Contractor shall submit for review of the Architect and/or Contractor and submittal to the Owner for his files, copies of Service Contracts with said agencies to perform these services. It shall be the responsibility of this Contractor to fill out and forward all warranty forms as required.
- D. This contractor shall arrange demonstrations of the operation and maintenance of all "Buy-Out" equipment by competent instructors. These demonstrations to take place within ten (10) days prior to the acceptance of the kitchen. All instruction periods shall be scheduled with the Architect and/or Consultant fourteen (14) days prior to commencement of same, and at times convenient to the Architect and/or consultant and Owner.

PART 4 - ITEMIZED EQUIPMENT SCHEDULE

4.01 FOOD SERVICE EQUIPMENT LIST AND DESCRIPTION

- A. Fabricated Equipment: Wherever the term "Fabricated Assembly" is used within the list noted below and description of Food Service Equipment, it shall be presumed to be followed by the phrase, "constructed to the configuration, dimension, detail and design as shown on the drawings and specifications and with workmanship and materials as specified above" and shall meet the Fabrication Detail Requirements of the latest edition of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA), and National Sanitation Foundation (NSF Standard 2).
- B. All Food Service Equipment shall be installed per the "Guidelines for Seismic Restraints of Kitchen Equipment" by the Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- C. All Food Service Equipment shall comply with the standards of The California Code of Regulations, Title 24, Part No. 2.
- D. All Food Service Equipment shall comply with the current California Energy Commission Appliance Efficiency Regulations.

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- E. Equipment in the following schedule is listed by Item Numbers shown on Drawings.
- F. Equipment listed is schedule as (OFCI) means Owner Furnished Contractor Installed.

1. SCHEDULED ITEMS

ITEM #1 AIR CURTAIN

Quantity: One (1)

Manufacturer: Berner (or equal)

Model: SLC07-1072A

Status: CFCI

Sanitation Series Low Profile Air Curtain, 72"L, unheated, (1) 1/5 hp motor, for doors up to 7' high, specify exterior, interior or exterior mounting, UL, cULus, UL EPH, MADE IN USA

Accessories:

- 1ea. Five year parts warranty (unheated units)
- 1ea. If special freight fees are requested, (See below) all applicable fees will be added to the invoice; fees subject to change; contact factory for addition information.
- 1ea. 120v/60/1-ph
- 1ea. White powder coat exterior finish, standard
- 2ea. Plunger/Roller Door Switch, NEMA 1, max. amp draw of 20 amps, 120-240v/1ph
- 1ea. Z Wall Bracket, adjustable depth, stainless steel finish, priced per each (one pair)

ITEM #2 WORK TABLE

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following:

- A. Work area top to be 14-gauge stainless steel with a 14-gauge stainless steel backsplash at back 2" thick with a 45-degree top edge to wall, turn down 1/2" at back.
- B. Top to be constructed with square edge 2" turn down at front edge with 1" return back.
- C. Legs to be 16-gauge stainless steel tubular, stainless steel welded leg sockets, stainless steel adjustable feet and stainless-steel cross rail bracing. Provide 16-gauge stainless steel under shelf as shown.
- D. Approximate size: 30" deep x Length as shown.

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ITEM #2.1 WALL SHELF

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following:

- A. To be 16-gauge stainless steel construction, 1 1/2" turn down in front and 2" turn up at back and right end and left ends. Provide 14-gauge stainless steel wall brackets as shown. Shelf to be stud welded with cap nuts (2) ea at each shelf bracket silicone shelf to brackets will not be allowed for attachment.
- B. Approximate Size: (1) ea. 12" deep x length as shown.

ITEM #3 PASS-THRU HEATED CABINET

Quantity: Two (2)

Manufacturer: True Mfg. - General Foodservice

Model: STA1HPT-1S-1S

Status: OFCI

Contractor to verify and supply utilities and anchorage with owner furnished equipment and DSA approved documents.

ITEM #4 PASS-THRU REFRIGERATOR

Quantity: Two (2)

Manufacturer: True Mfg. - General Foodservice

Model: STA1RPT-1S-1S-HC

Status: OFCI

Contractor to verify and supply utilities and anchorage with owner furnished equipment and DSA approved documents.

ITEM #5 BASE CABINET WITH STORAGE

Quantity: One (1)

Manufacturer: Multiteria (or equal)

Model: FABRICATED ITEM

Status: CFCI

Item 5A – UTILITY COUNTER (1 REQ'D)
Multiteria Model ULS84-MOD

Essence series Utility Counter, 84-3/4"L x 34"W, 1" x 1" 16 gauge tubular stainless steel frame construction, joints to be welded, ground and polished.

Accessories:

AMD FOODSERVICE DESIGN
31860710000

FOODSERVICE EQUIPMENT
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- 34" high.
- Countertop, solid surface, make and model to be determined, with 1-1/2" square turndown on front and ends. 4" high back splash integral to counter top. Counter top edges between abutting counters will be cut square and prepped for field seaming. If counter tops are not seamed with these square edges, the tops may not align properly. With counter tops seamed, counters will be non-movable. Seaming must be completed on site by a certified installer and is not part of Multiteria scope. Epoxy/glue and (1) dispenser gun included for full project.
- Laminate front panel shall be 3/4" thick MDO with standard laminate, make/model/finish/grain direction (vertical or horizontal) to be determined, and shall have matching vinyl edge banding and laminate liner material for panel backing, with matching hinged doors. Matching laminate end panel. Panels shall be bolted on, not removable.
- S/s welded closure on back.
- Provisions for bolting counters together.
- Seismic legs with flanged feet.

Item 5B – UTILITY COUNTER (1 REQ'D)
Multiteria Model ULS84-MOD

Essence series Utility Counter, 84"L x 34"W, 1" x 1" 16 gauge tubular stainless steel frame construction, joints to be welded, ground and polished.

Accessories:

- 34" high.
- Countertop, see item 5A for details.
- Laminate front panel shall be 3/4" thick MDO with standard laminate, make/model/finish/grain direction (vertical or horizontal) to be determined, and shall have matching vinyl edge banding and laminate liner material for panel backing, with matching hinged doors. Matching laminate end panel. Panels shall be bolted on, not removable.
- Multiteria to furnish and install sink and faucet into counter as shown on drawing.
- Open back at sink for utility access to building wall.
- S/s welded closure on back where noted on drawing.
- Provisions for bolting counters together.
- Seismic legs with flanged feet.

Item 5C – UTILITY COUNTER (1 REQ'D)
Multiteria Model ULS84-MOD

Essence series Utility Counter, 84-3/4"L x 34"W, 1" x 1" 16 gauge tubular stainless steel frame construction, joints to be welded, ground and polished.

Accessories:

- 34" high.

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- Countertop, solid surface, make and model to be determined, with 1-1/2" square turndown on front and ends. 4" high back splash integral to counter top. Counter top edges between abutting counters will be cut square and prepped for field seaming. If counter tops are not seamed with these square edges, the tops may not align properly. With counter tops seamed, counters will be non-movable. Seaming must be completed on site by a certified installer and is not part of Multiteria scope. Epoxy/glue and (1) dispenser gun included for full project.
- Laminate front panel shall be 3/4" thick MDO with standard laminate, make/model/finish/grain direction (vertical or horizontal) to be determined, and shall have matching vinyl edge banding and laminate liner material for panel backing, with matching hinged doors. Matching laminate end panel. Panels shall be bolted on, not removable.
- S/s welded closure on back.
- Provisions for bolting counters together.
- Seismic legs with flanged feet.

ITEM #6 HOSE REEL

Quantity: One (1)

Manufacturer: Fisher (or equal)

Model: 29851

Status: CFCI

Hose Reel Assembly, closed reel rinse wall mounted with spray valve, powder coated steel construction, 30 feet of 3/8"ID, 3 ply hose, working pressure of 200 psi, withstands 160° F water temperature, 1/2" NPT Female garden hose inlet

Accessories:

- 1ea. Reel Rinse Control Unit, valves, gauges and connections are completely enclosed within a stainless steel cabinet, dual check backflow preventer, water hammer silencer, 90° panel lock, padlock hasp & finger latch, 1/2" NPT female inlets & outlets

ITEM #7 SOILED DISHTABLE

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following:

- A. Work area top to be 14-gauge stainless steel with a 14-gauge stainless steel backsplash 2" thick with a 45-degree top edge to wall, turn down 1/2" at back and right side to Z-Clips. Top to be constructed with a "rolled" edge as shown. Drain boards are to slope per NSF guidelines to dishwasher Item No. 10.
- B. Provide and install 16-gauge stainless steel tubular legs, stainless steel welded leg sockets, stainless steel adjustable feet and 16-gauge welded tubular stainless undershelf.

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- C. Provide adjustable seismic flanged feet. Refer to drawings for configuration and quantity.
- D. Approximate size: 30" deep x as shown.
- F. Sump drain: Sump drain to be provided with removable non-slash drip grate model #J80-5109 also to be provided with drain item #E16-41-71.
- G. Approximate size: 24" deep x as shown.

ITEM #8 CLEAN DISHTABLE

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following:

- A. Work area top to be 14-gauge stainless steel with a 14-gauge stainless steel backsplash 2" thick with a 45-degree top edge to wall, turn down ½" at back and right side to Z-Clips. Top to be constructed with a "rolled" edge as shown. Drain boards are to slope per NSF guidelines to dishwasher Item No. 10.
- B. Provide and install 16-gauge stainless steel tubular legs, stainless steel welded leg sockets, stainless steel adjustable feet and 16-gauge welded tubular stainless undershelf.
- C. Provide adjustable seismic flanged feet. Refer to drawings for configuration and quantity.
- D. Approximate size: 30" deep x as shown.
- F. Sump drain: Sump drain to be provided with removable non-slash drip grate model #J80-5109 also to be provided with drain item #E16-41-71.
- G. Approximate size: 24" deep x as shown.

ITEM #9 SERVING COUNTER

Quantity: Two (2)

Manufacturer: Multiteria (or equal)

Model: FABRICATED ITEM

Status: CFCI

Item 9 – UTILITY COUNTER (2 REQ'D)

Multiteria Model ULS78-MOD

Essence series Utility Counter, 72 7/8"L x 34"W, 1" x 1" 16 gauge tubular stainless steel frame construction, joints to be welded, ground and polished. Vertical framework at front of counter to incorporate support posts for food shield. Stainless steel apron to be provided on operator side to mount controls.

Accessories:

- 34" high.

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- Countertop, solid surface, make and model to be determined, with extended top tray slide with stainless steel runners as shown on drawing bringing overall width of counter to 44". with 5" square turndown on front. Counter top edges between abutting counters will be cut square and prepped for field seaming. If counter tops are not seamed with these square edges, the tops may not align properly. With counter tops seamed, counters will be non-movable. Seaming must be completed on site by a certified installer and is not part of Multiteria scope. Epoxy/glue and (1) dispenser gun included for full project.
- End splash, solid surface with substrate, make and model to match counter top, shipped loose. Size as shown on drawing.
- Waterfall front, solid surface with substrate, make and model to match counter top, shipped loose in (1) 48-1/2" long x 24-3/8" high section as shown on drawing. Application to pony wall on site by others.
- Drop-in hot/cold/freeze food wells, dry operation, no drains, 3-well size. Top mount, stainless steel formed, welded and polished, sealing gasket. Holds standard 12" x 20" steam table pans, 2-1/2" thru 6" deep. Touch screen controls, 1 control per food well. Controls mounted in counter apron. R448a refrigerant. Compressor slides out for easy service. 120/208V, 11 amps total. Locate in counter as shown on drawing.
- Well cover for hot/cold/freeze well included.
- Food shield, 54" two-tier, adjustable front glass, drop-in aluminum flush heated shelf in 1st tier, heated shelf with 48" long x 15-1/2" wide heated surface. With LED lighting, 3/8" clear tempered glass shelves, front glass and (1) glass end panel. No glass end panel adjacent to building wall. 1" x 2" supports to be mounted through counter top and into counter vertical framework. Specify black powder coat (RAL 9005 smooth matte) or stainless steel brushed finish on posts, brackets and hardware. Power switch for lighting mounted in counter apron.
- No laminate panels.
- Stainless steel hinged louvered doors at compressor.
- J-box in counter base for hot/cold/freeze unit, wired to electrical load center.
- J-box in counter base for food shield lights, wired to electrical load center.
- Electrical receptacle in counter base for heated shelf, wired to electrical load center.
- Electrical load center, 120/208V, 1 phase, with amp loads and service requirements as shown on drawing. Load center will include all conduit feeders to individual counters electrical connections. Counter manufacturer to provide wiring diagrams and panel schedules indicating breaker sizes and circuit designations.
- Provisions for bolting counters together.
- Seismic legs with flanged feet.

Item 9A – UTILITY COUNTER (2 REQ'D)
Multiteria Model ULS78-MOD

Essence series Utility Counter, 72 7/8"L x 34"W, 1" x 1" 16 gauge tubular stainless steel frame construction, joints to be welded, ground and polished. Vertical

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framework at front of counter to incorporate support posts for food shield. Stainless steel apron to be provided on operator side to mount controls.

Accessories:

- 34" high.
- Countertop, see item 9 for details.
- End splash, solid surface with substrate, make and model to match counter top, shipped loose. Size as shown on drawing.
- Drop-in hot/cold/freezer food wells, dry operation, no drains, 3-well size. Top mount, stainless steel formed, welded and polished, sealing gasket. Holds standard 12" x 20" steam table pans, 2-1/2" thru 6" deep. Touch screen controls, 1 control per food well. Controls mounted in counter apron. R448a refrigerant. Compressor slides out for easy service. 120/208V, 11 amps total. Locate in counter as shown on drawing.
- Well cover for hot/cold/freezer well included.
- Food shield, 54" two-tier, adjustable front glass, drop-in aluminum flush heated shelf in 1st tier, heated shelf with 48" long x 15-1/2" wide heated surface. With LED lighting, 3/8" clear tempered glass shelves, front glass and (1) glass end panel. No glass end panel adjacent to building wall. 1" x 2" supports to be mounted through counter top and into counter vertical framework. Specify black powder coat (RAL 9005 smooth matte) or stainless steel brushed finish on posts, brackets and hardware. Power switch for lighting mounted in counter apron.
- No laminate panels.
- Open storage on operator side with stainless steel removable under shelf.
- Stainless steel hinged louvered doors at compressor.
- J-box in counter base for hot/cold/freezer unit, with wiring to electrical load center.
- J-box in counter base for food shield lights, with wiring to electrical load center.
- Electrical receptacle in counter base for heated shelf, with wiring to electrical load center.
- Electrical receptacle in counter apron for convenience, with wiring to electrical load center.
- Provisions for bolting counters together.
- Seismic legs with flanged feet.

ITEM #10 DISHWASHER, CONVEYOR TYPE

Quantity: One (1)

Manufacturer: Hobart

Model: CL44-ADV+BUILDUP

Status: CFCI

Contractor to verify and supply utilities and anchorage with owner furnished equipment and DSA approved documents.

ITEM #11 DISPOSER

Quantity: One (1)

Manufacturer: Salvajor (or equal)

AMD FOODSERVICE DESIGN
31860710000

FOODSERVICE EQUIPMENT
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Model: 200-SA-3-ARSS-2

Status: CFCI

Disposer, Sink Assembly, 3-1/2" sink collar, 2 Hp motor, start/stop push button, automatic reversing ARSS-2 control, includes fixed nozzle, chrome plated vacuum breaker, solenoid valve, sink stopper & flow control, heat treated aluminum alloy housing, UL, CE

Accessories:

- 1ea. 208v/60/1-ph, 12.1 amps
- 1ea. Offset Chute, stainless steel construction, includes (3) disposer support legs with stainless steel bolt down flanges
- 1ea. Disposer support leg, for 3/4 HP - 2 HP disposers
- 1ea. Seismic flange foot for support leg

ITEM #12 OPEN DISPLAY MERCHANDISER

Quantity: Four (4)

Manufacturer: True Mfg. - General Foodservice

Model: TOAM-72GS-HC~NSL01

Status: OFCI

Contractor to verify and supply utilities and anchorage with owner furnished equipment and DSA approved documents.

ITEM #13 DISPLAY CASE, HEATED, FLOOR MODEL

Quantity: One (1)

Manufacturer: Alto-Shaam

Model: HSM-48/5S/T

Status: OFCI

Contractor to verify and supply utilities and anchorage with owner furnished equipment and DSA approved documents.

ITEM #14 OPEN DISPLAY MERCHANDISER

Quantity: Two (2)

Manufacturer: True Mfg. - General Foodservice

Model: TOAM-72GS-HC~NSL01

Status: OFCI

Contractor to verify and supply utilities and anchorage with owner furnished equipment and DSA approved documents.

ITEM #15 HAND SINK

Quantity: One (1)

Manufacturer: Eagle Group (or equal)

Model: HSAP-14-ADA-FW

STAT: CFCI

Hand Sink, wall mount, 14" wide x 16" front-to-back x 5" deep bowl, 16/304 stainless steel construction, splash mount gooseneck faucet with wrist handles & mixer valve, marine edge on

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31860710000

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front & sides, 1/2" NPS water inlet, chrome-plated P-trap, wrist handles, soap dispenser, basket drain, skirt assembly & paper towel dispenser, PHYSICALLY CHALLENGED, NSF

Accessories:

- 2ea. Model -LRS Left & right-side splashes
- 2ea. Model 300966 Mini Crumb Cup, for 1-1/2" drain
- 2ea. Model 324074 Soap Dispenser, deck mounted, 16 oz
- 2ea. Model 300791 Tail Piece, for 1-1/2 IPS connection, nickel-plated
- 2ea. Model 300789 P-Trap, nickel-plated
- 2ea. Model 313305 T&S Extra Heavy Duty Gooseneck Faucet, wrist handles, splash mount 4" OC, NSF

ITEM #16 CASHIER COUNTER

Quantity: One (1)

Manufacturer: Multiteria (or equal)

Model: CS66-MOD

STAT: CFCI

Essence series Cashier Counter, 81-1/5"L x 30"W, 1" x 1" 16 gauge tubular stainless steel frame construction, joints to be welded, ground and polished.

Accessories:

- 34" high.
- Cashier station to meet ADA requirement with No cash drawer or under shelf.
- Countertop, solid surface, make and model to be determined, with extended top tray slide with stainless steel runners as shown on drawing with 1-1/2" turn down of front and ends.
- (2) Grommet holes in countertop, located as shown on drawing.
- Laminate front and (2) end panels shall be 3/4" thick MDO with standard laminate, make and model to be determined, and shall have matching vinyl edge banding and laminate liner material for panel backing. Panel shall be bolted on, not removable.
- (2) NEMA 5-15R receptacles in counter base for POS system with 8' cord sets with NEMA 5-15P plugs.
- (2) Empty data boxes in counter base.
- Set of casters, swivel with (2) locking.

ITEM #17 TWO (2) COMPARTMENT SINK

Quantity: One (1)

Manufacturer: Eagle Group (or equal)

Model: FN2036-2-24-14/3

Status: CFCI

Spec-Master® FN Series Sink, two compartment, 88"W x 27"D, 14/304 stainless steel top, coved corners, 18" wide x 20" front-to-back x 14" deep compartments, 24" drainboards on left & right, 9-1/2"H backsplash with 1" turn down to z-clip, 8" OC splash mount faucet holes, rolled edges on front & sides, includes 3-1/2" basket drains, stainless steel crossbracing on all sides, stainless steel legs & adjustable flanged feet, NSF

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Accessories:

- 1 ea. Faucet, 14" long, splash-mounted mixing faucet, 8" centers, swing nozzle, NSF
- 2 ea. Fisher Model 22209 DrainKing Waste Valve, with flat strainer, 12 GPM drain rate, dual Teflon seals, stainless steel ball, cast red brass body

ITEM #19 MOBILE WORKTABLE W/ UTENSIL DRAWER

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following:

- A. Work area top to be 14-gauge stainless steel with 2" turn down on all four sides.
- B. Provide and install 16-gauge stainless steel tubular legs, stainless steel welded leg sockets, and fully welded stainless-steel cross rail bracing. Provide 16-gauge stainless steel undershelf as shown.
- C. Provide swivel expanding stem casters Component Hardware Group, Inc. (4) ea. Model CMS4- 4GBN brake model.
- D. Provide (1) ea. utensil drawer Component Hardware Group, Inc. Model S90-0020N drawer mounted to the underside of mobile worktable Item No. 15. Provide all necessary hardware mounting angles etc. for a complete installation. Slides to be installed so drawer will roll closed when released.

ITEM #20 COMBI OVEN, ELECTRIC

Quantity: Two (2)

Manufacturer: RATIONAL

Model: ICP 20-FULL E 480V 3 PH (LM100GE)

Status: CFCI

Contractor to verify and supply utilities and anchorage with owner furnished equipment and DSA approved documents.

ITEM #21 EXHAUST HOOD W/ STAINLESS STEEL WALL LINING

Quantity: One (1)

Manufacturer: STREIVOR AIR SYSTEMS

Model: FABRICATED ITEM

STAT: CFCI

Model: WCBD 173 66 22.5

Maximum Appliance Type : 450F I Medium Duty

Project: Luther Burbank HS

Item#21 B

Qty: 1

CKV Hood UL Listed 710 Hood Exhaust : 3028

CKV Lights UL Listed 1571 External Front MUA: 2424

AMD FOODSERVICE DESIGN
31860710000

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CFM @ 0.63 (WC) SP

CFM @ 0.40 (WC) SP

Commercial Kitchen Ventilation Specification

See plans for location and placement of item with reference to adjoining equipment. Furnish and install per Manufacturer's standard specifications and the following:

- Install in the location as shown on drawings. It is the responsibility of the Installer to verify all clearances and stand offs from the hood to limited combustibles and/or combustible materials. Hood must be installed in accordance with the Manufacturer's specifications. Canopy Hoods to be installed a minimum of 78 inches above the finished floor and level. ADA requires 80 inches minimum above the finished floor.
 - The Hood assembly to be size and shape per the drawings. Hood to be U.L. listed #710, NSF listed and built in compliance with the prevailing NFPA Standard #96. The hood ends shall be fabricated from 16 gauge stainless steel or heavier and have a Performedge shape at the lower most part of the end. The remainder of the hood will be fabricated of material not less than 18 gauge. All exposed surfaces to be fabricated from Type 304 stainless steel with a #4 finish. All exposed welds to be ground smooth and polished to a #4 finish. Exhaust airflow volume and static pressure at the duct collar(s) shall not exceed those shown on the drawings.
 - Stainless steel matching enclosure panels from the top of the Hood to the finished ceiling to be furnished by KEC. (Verify ceiling height with plan.)
- * All electrical connections, materials and labor to connect high and low voltage electrical to the hood lights, temperature monitors, electrical components and/or the Fire Suppression System including micro-switch(es) by other. See fire suppression system for additional detail.
- Hood Manufacturer to provide engineering and shop drawings for approval prior to fabrication.
 - Exhaust and Supply Fans to be furnished by Mechanical Division in compliance with local and National Codes. See Hood Manufacturer's specification sheets for CFM and static pressure requirements.
 - Duct connections by Mechanical. An air balance test should be performed before cooking start up to insure correct exhaust and supply airflow rates.
 - Hood must be manufactured UL 710 Listed, NFPA 96 compliant and installed in accordance with all prevailing codes and standards.

Extractor

FLSS Hood to be fitted with stainless steel baffle filters. Filters to be UL1046 Listed, NSF approved. The filters will be easily removable for cleaning.

Exposed Canopy Material

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31860710000

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304 Stainless Steel Type 304 Stainless Steel (SS) is in the "Austenitic group of SS" comprising approximately 18% chromium and 8% nickel. Type 304's resistance to corrosive acids makes it ideal for hoods, sinks and tabletops. Type 304 SS is comprised of no more than 0.8% carbon and at least 50% iron. The chromium binds oxygen to the surface of the product to protect the iron from oxidation (rust). Nickel also enhances the corrosion resistance of stainless steel. Therefore, the higher the nickel content, the more resistant the stainless steel is to corrosion. Type 304 SS is non-magnetic.

Non-Exposed Exhaust Plenum Material

304 Stainless Steel Type 304 Stainless Steel (SS) is in the "Austenitic group of SS" comprising approximately 18% chromium and 8% nickel. Type 304's resistance to corrosive acids makes it ideal for hoods, sinks and tabletops. Type 304 SS is comprised of no more than 0.8% carbon and at least 50% iron. The chromium binds oxygen to the surface of the product to protect the iron from oxidation (rust). Nickel also enhances the corrosion resistance of stainless steel. Therefore, the higher the nickel content, the more resistant the stainless steel is to corrosion. Type 304 SS is non-magnetic.

Make Up Air

SPD

Hood to have a full length add on supply plenum fabricated of 18 gauge stainless steel (material type and finish to be the same as the hood) that facilitates the delivery of downward supply air through a full length perforated metal. (See drawings for location and size). All welds to be polished to a #4 finish. Plenum is to be factory welded to the hood.

Light Fixture

Surface Mounted Warm LED

Hood to be fitted with UL & NSF Listed Surface Mounted Commercial Kitchen Hood light fixtures. Light fixture to have brushed aluminum housing, tempered glass, shatter resistant globe. Light fixture(s) to be prewired to a single connection point for each hood. To be fitted with LED lamp.

Lamps

Surface Mounted Warm LED

LED lamp, 120vac, UL Listed for exhaust canopy hoods, 12 Watt, 960 Lumens, 4500K to 5500K, maximum operating temperature 80 degrees C (176°F). 120 degree Beam angle, rated for 50,000 hour lamp life, mercury-free, instant (no ballast), exceeds Federal Energy Act requirement, no ultraviolet light emission. Fits any A19/E261E27 fixture (globe must be installed to comply with UL listing).

BalanceAire Exhaust Damper

Hood to be fitted with a UL710 Listed, internally adjustable opposed blade variable volume damper(s) per the size and shape of the drawings. The opposed blades to include a positioning

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bracket that allows the damper blades to be adjusted from 5% to 100% open. Each positioning bracket to have a locking/unlocking fastener on the inside of the damper that is accessible from inside of the hood that locks the damper blade in place. Damper to be manufactured from 18 gauge of the same material type and finish as the hood exhaust plenum.

Auto Fan Start

An Auto Fan Start is required for NFPA 96 Section 8.2.3.3. Auto Fan Switches may be located in each hood exhaust collar or the hood canopy. Auto Fan Switches in the canopy have a maximum spacing of 84".

Access Enclosure Hood Exhaust Collar Mounted

Hood Exhaust Collar to be fitted with UL 710 listed Access Enclosure(s) size and shape per the drawing with a removable cover plate that protects and allows access to monitoring equipment from inside of the hood exhaust plenum. The removable cover to be held in place by stainless steel fasteners. When the Enclosure's cover is removed it allows easy access for installation, adjustments and service to the equipment inside the hood exhaust collar. Access Enclosures to be fabricated from 18 gauge stainless steel of the same material and with the same finish as the hood. All welds to be ground smooth and polished to a #4 finish.

Hood Utility Cabinet

Hood Utility Cabinet (HUC) assembly to be per size and shape shown on the drawing. Cabinet constructed with angle iron frame and stainless steel body. All exposed surfaces to be fabricated of 18 gauge Type 304 stainless steel (s/s) with a #4 finish. All exposed welds to be ground smooth and polished to a #4 finish. Cabinet has an open top to enable utility connections from above ceiling and a stainless steel lift out removable door panel. The removable door panel to have a recessed s/s door pull, full grip type. The removable door panel to be held in place by a full length upper and lower channel.

Ceiling Enclosure

Stainless steel matching enclosure panels from the top of the Hood to the finished ceiling. (Verify ceiling height with plan.) Ceiling Enclosure panels to be fabricated of 18 gauge stainless steel (material type and finish to be the same as the hood). Any exposed welds to be ground smooth and polished to a #4 finish.

Model: WCBD 173 66 22.5

Maximum Appliance Type : 450F I Medium Duty

Project: Luther Burbank HS

Item#21 A Qty: 1

CKV Hood UL Listed 710 Hood Exhaust : 3028

CKV Lights UL Listed 1571 External Front MUA: 2424

CFM @ 0.63 (WC) SP

CFM @ 0.40 (WC) SP

Commercial Kitchen Ventilation Specification

See plans for location and placement of item with reference to adjoining equipment. Furnish and install per Manufacturer's standard specifications and the following:

AMD FOODSERVICE DESIGN
31860710000

FOODSERVICE EQUIPMENT
11 40 00 - 27

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- Install in the location as shown on drawings. It is the responsibility of the Installer to verify all clearances and stand offs from the hood to limited combustibles and/or combustible materials. Hood must be installed in accordance with the Manufacturer's specifications. Canopy Hoods to be installed a minimum of 78 inches above the finished floor and level. ADA requires 80 inches minimum above the finished floor.
 - The Hood assembly to be size and shape per the drawings. Hood to be U.L. listed #710, NSF listed and built in compliance with the prevailing NFPA Standard #96. The hood ends shall be fabricated from 16 gauge stainless steel or heavier and have a Performedge shape at the lower most part of the end. The remainder of the hood will be fabricated of material not less than 18 gauge. All exposed surfaces to be fabricated from Type 304 stainless steel with a #4 finish. All exposed welds to be ground smooth and polished to a #4 finish. Exhaust airflow volume and static pressure at the duct collar(s) shall not exceed those shown on the drawings.
 - Stainless steel matching enclosure panels from the top of the Hood to the finished ceiling to be furnished by KEC. (Verify ceiling height with plan.)
- * All electrical connections, materials and labor to connect high and low voltage electrical to the hood lights, temperature monitors, electrical components and/or the Fire Suppression System including micro-switch(es) by other. See fire suppression system for additional detail.
- Hood Manufacturer to provide engineering and shop drawings for approval prior to fabrication.
 - Exhaust and Supply Fans to be furnished by Mechanical Division in compliance with local and National Codes. See Hood Manufacturer's specification sheets for CFM and static pressure requirements.
 - Duct connections by Mechanical. An air balance test should be performed before cooking start up to insure correct exhaust and supply airflow rates.
 - Hood must be manufactured UL 710 Listed, NFPA 96 compliant and installed in accordance with all prevailing codes and standards.

Extractor

FLSS Hood to be fitted with stainless steel baffle filters. Filters to be UL1046 Listed, NSF approved. The filters will be easily removable for cleaning.

Exposed Canopy Material

304 Stainless Steel Type 304 Stainless Steel (SS) is in the "Austenitic group of SS" comprising approximately 18% chromium and 8% nickel. Type 304's resistance to corrosive acids makes it ideal for hoods, sinks and tabletops. Type 304 SS is comprised of no more than 0.8% carbon and at least 50% iron. The chromium binds oxygen to the surface of the product to protect the iron from oxidation (rust). Nickel also enhances the corrosion resistance of stainless steel.

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Therefore, the higher the nickel content, the more resistant the stainless steel is to corrosion. Type 304 SS is non-magnetic.

Non-Exposed Exhaust Plenum Material

304 Stainless Steel Type 304 Stainless Steel (SS) is in the "Austenitic group of SS" comprising approximately 18% chromium and 8% nickel. Type 304's resistance to corrosive acids makes it ideal for hoods, sinks and tabletops. Type 304 SS is comprised of no more than 0.8% carbon and at least 50% iron. The chromium binds oxygen to the surface of the product to protect the iron from oxidation (rust). Nickel also enhances the corrosion resistance of stainless steel.

Therefore, the higher the nickel content, the more resistant the stainless steel is to corrosion. Type 304 SS is non-magnetic.

Make Up Air

SPD

Hood to have a full length add on supply plenum fabricated of 18 gauge stainless steel (material type and finish to be the same as the hood) that facilitates the delivery of downward supply air through a full length perforated metal. (See drawings for location and size). All welds to be polished to a #4 finish. Plenum is to be factory welded to the hood.

Light Fixture

Surface Mounted Warm LED

Hood to be fitted with UL & NSF Listed Surface Mounted Commercial Kitchen Hood light fixtures. Light fixture to have brushed aluminum housing, tempered glass, shatter resistant globe. Light fixture(s) to be prewired to a single connection point for each hood. To be fitted with LED lamp.

Lamps

Surface Mounted Warm LED

LED lamp, 120vac, UL Listed for exhaust canopy hoods, 12 Watt, 960 Lumens, 4500K to 5500K, maximum operating temperature 80 degrees C (176°F). 120 degree Beam angle, rated for 50,000 hour lamp life, mercury-free, instant (no ballast), exceeds Federal Energy Act requirement, no ultraviolet light emission. Fits any A19/E261E27 fixture (globe must be installed to comply with UL listing).

BalanceAire Exhaust Damper

Hood to be fitted with a UL710 Listed, internally adjustable opposed blade variable volume damper(s) per the size and shape of the drawings. The opposed blades to include a positioning bracket that allows the damper blades to be adjusted from 5% to 100% open. Each positioning bracket to have a locking/unlocking fastener on the inside of the damper that is accessible from inside of the hood that locks the damper blade in place. Damper to be manufactured from 18 gauge of the same material type and finish as the hood exhaust plenum.

Auto Fan Start

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An Auto Fan Start is required for NFPA 96 Section 8.2.3.3. Auto Fan Switches may be located in each hood exhaust collar or the hood canopy. Auto Fan Switches in the canopy have a maximum spacing of 84".

Access Enclosure Hood Exhaust Collar Mounted

Hood Exhaust Collar to be fitted with UL 710 listed Access Enclosure(s) size and shape per the drawing with a removable cover plate that protects and allows access to monitoring equipment from inside of the hood exhaust plenum. The removable cover to be held in place by stainless steel fasteners. When the Enclosure's cover is removed it allows easy access for installation, adjustments and service to the equipment inside the hood exhaust collar. Access Enclosures to be fabricated from 18 gauge stainless steel of the same material and with the same finish as the hood. All welds to be ground smooth and polished to a #4 finish.

Hood Utility Cabinet

Hood Utility Cabinet (HUC) assembly to be per size and shape shown on the drawing. Cabinet constructed with angle iron frame and stainless steel body. All exposed surfaces to be fabricated of 18 gauge Type 304 stainless steel (s/s) with a #4 finish. All exposed welds to be ground smooth and polished to a #4 finish. Cabinet has an open top to enable utility connections from above ceiling and a stainless steel lift out removable door panel. The removable door panel to have a recessed s/s door pull, full grip type. The removable door panel to be held in place by a full length upper and lower channel.

Ceiling Enclosure

Stainless steel matching enclosure panels from the top of the Hood to the finished ceiling. (Verify ceiling height with plan.) Ceiling Enclosure panels to be fabricated of 18 gauge stainless steel (material type and finish to be the same as the hood). Any exposed welds to be ground smooth and polished to a #4 finish.

Model: DemandAire Silver Variable Speed DCKV System

Project: Luther Burbank HS

Item# 21 Z

Hoods Controlled : #21 A#21 B

UL Listed 508A

- * See plans for location and placement of item with reference to adjoining equipment. See schematics for utility connection and operation. Furnish and install per Manufacturer's standard specifications and the following:
- * Install in the location as shown on drawings. It is the responsibility of the Installer to verify all clearances.
- * The Demand Control Kitchen Ventilation (DCKV) System is to be compliant with the prevailing energy codes including ASHRAE/ANSI 90.1 and California Title 24.
- * DCKV Systems are to be UL 508A listed and shall be capable of at least a 50% reduction in exhaust and replacement air system airflow rates, including controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent and combustion products during cooking and/or idle.

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- * DCKV Systems shall provide connections for a run signal for each supply and exhaust fan(s).
- * DCKV Systems shall include failsafe controls that result in full fan flow upon a cooking sensor failure, and an adjustable timed override to allow occupants the ability to temporarily override the system to full fan flow.
- * DCKV Systems shall include Ambient Temperature Monitoring (ATM) to monitor the temperature of the air in the kitchen space surrounding the hood system.
- * DCKV Systems shall include Zone Temperature Monitoring controls that monitor the totality of cooking appliances below each hood. Temperature monitors are to be installed in the hood exhaust collar(s) to measure the hood exhaust air temperature.
- * DCKV Systems shall include UL 710 Listed access enclosure(s) that allow access to the temperature monitors from below the hood for installation and commissioning. Systems that include temperature monitors or other electrical components which are not accessible from below the hood(s) via UL 710 listed access enclosure(s) are not acceptable.
- * DCKV Systems shall compare hood temperatures to the ambient temperature of the kitchen space to determine the state of cooking appliances. Power supplied to the exhaust and/or supply fan(s) shall be adjusted to meet the cooking appliance demand using differential controls and an algorithm to optimize energy savings.
- * DCKV Systems shall include fan and lighting controls, diagnostic tools, system settings, and alarm notifications to be provided by means of a Human Machine Interface (HMI) with color touch screen. The HMI is door mounted to a Type I UL Listed stainless steel enclosure which may be recessed into a wall, surfaced mounted on a wall, or flush mounted on the front of a hood utility cabinet.
- * DCKV Systems shall include a Programmable Logic Controller (PLC), 24 VDC power supply, relays, terminal blocks, color-coded wiring, housed in Type I UL Listed stainless steel enclosures which may be hood mounted in a utility cabinet or be wall mounted, surface or recessed.
- * The HMI shall include manual controls including a 50% exhaust power switch, 100% power switch with timed override, and hood on/off light switch. The HMI shall include diagnostic tools and display screen for hood and ambient temperature status, fan motor status and control history, and audible/visual alarm notification.
- * The HMI shall include password protected settings for temperature monitor set points, minimum and maximum fan speeds to assist with air balancing, 100% override time, fan off-delay time, alarm triggers and fire suppression system settings.
- * DCKV Systems shall provide analog control signals to VFDs, Electronically Commutated (EC) Motors, or BMS (not provided by the manufacturer unless specifically included herein) to control the exhaust and supply fans at variable speeds based on the cooking conditions below each hood based on inputs from hood and ambient temperature monitors, manual controls from the HMI, and fire suppression system actuation.
- * DCKV Systems Do not include Variable Frequency Drive(s).
- * DCKV Systems shall be capable of providing real time system status such as hood and ambient temperature data, system faults, fan power operating status and other information via Modbus TCP communication.

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- * Hood and ambient temperature monitors shall be stainless steel Platinum 100 3-Wire Resistance Temperature Detectors (RTD).
- * DCKV Systems shall be engineered with connections for shunting electrical equipment below the hood, shunting electric gas valves, shunting SmartAire Internal Hood Fans (IHF), shunting makeup air, operating exhaust fans at full capacity and signaling building alarm system during a fire suppression system actuation.
- * DCKV Systems shall have an integrated electric gas valve reset relay that is accessed via the HMI and requires manual reset of the power to the electric gas valve(s) after the fire suppression system has been rearmed following a fire suppression system actuation or loss of power.
- * Manufacturer will provide DCKV control schematics, installation and operation manuals, and sequence of operation documents.
- * Manufacturer will provide pre-installation phone consultation to answer questions regarding the DCKV system.
- * Manufacturer may provide on-site commissioning support during startup of the hood system(s). See contract for on-site duration allocated for commissioning if applicable.
- * (Manufacturer will not provide) control panel supply power (120VAC, 20 amps), electric gas valve supply power (120VAC, 20 amps), high voltage VFD supply power, VFDs (Variable Frequency Drives), or field wiring between DCKV control panel and RTD temperature monitors, fire suppression system microswitches, HMI, shunt trip breakers, BMS, exhaust and supply fan VFDs, exhaust and supply fan motors, electrical gas valve(s), and hood lights, unless specifically noted herein or any other unspecified materials or labor.
- * The above exclusions, including labor and materials, to be provided by qualified contractor at no expense to Manufacturer.

ITEM #22 THREE TEIR DRAWER

Quantity: Two (2)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABIRCATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following: To be fabricated of 16-gauge stainless steel complete with the following hardware items.

- A. Provide stainless steel flush pull, Component Hardware Group, Inc., model no. P63-1012, installed into the 18-gauge double-pan drawer front panel.
- B. Provide stainless steel locks, Component Hardware Group, Inc., model no P30-4781 for each drawer. All drawers are to be keyed alike.
- C. Provide stainless steel full extension slides, Component Hardware Group, Inc., model No. S52-0024. Provide two (2) per drawer. Slides to be installed so drawer will roll closed when released.

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- D. Provide stainless steel removable drawer pan. Provide Component Hardware Group, Inc., model No. S81-1520 one (1) per drawer. Pan should be easily lifted out of drawer frame for cleaning.
- E. Drawer face panel to be constructed of 16-gauge stainless steel double pan construction. Single metal drawer faces are not acceptable.

ITEM #23 CHEFS TABLE

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following: To be constructed of 14-gauge stainless steel complete with stainless steel finished ends and back. Provide accessible work area as shown.

- A. Top to be 14-gauge stainless steel complete with 2" turn downs on 4 sides and a working height of 2'-10".
- B. Base section to be 16-gauge stainless steel formed metal construction complete with 16-gauge stainless steel bottom and mid shelves. Provide accessible work area as shown.
- C. Provide 1 5/8" dia. Stainless steel tube legs with Component Hardware Group, Inc. A10-0851 adjustable foot insert.
- D. Provide (2) Component Hardware Group, Inc., model No. R58-1020 double-faced pedestal type electrical outlets with model No. R71-0721 stainless steel face plates. All electrical outlets to be provided with empty conduit all interconnected to one point connection at end of counter.
- E. Item(s) to be included as part of this are item(s) - # 22,24.
- F. Provide adjustable seismic flanged feet. Refer to drawings for configuration and quantity.

ITEM #24 CHEFS SINK

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following:

- A. Sink to be one (1), 14-gauge stainless-steel formed and welded sink, refer to drawings for bowl dimensional requirements. (Diecast sink bows are not acceptable). Sink to be fully welded into countertop Item #23.
- B. This item is to be included as part of the fabrication of Item #23.
- C. Contractor to install seismic flanged feet where necessary.
Accessories:

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- 1 ea. T&S Brass Model B-1111 Faucet, 8" swing nozzle, deck mounted, quarter-turn Eterna cartridges, lever handles, low lead, ADA Compliant
- 1 ea. T&S Brass Model B-1100-KIT 24" Inlet Supply Hoses (3/8" Compression x 1/2" NPSM Female)
- 1 ea. Fisher Model 22209 DrainKing Waste Valve, with flat strainer, 12 GPM drain rate, dual Teflon seals, stainless steel ball, cast red brass body
- 1 ea. Fisher 5-year warranty against defects in materials or workmanship, standard
- 2 ea. Fisher Model 5000-2103 Close Elbow, 3/4" female, rough chrome

ITEM #25 CHEFS COUNTER

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following: To be constructed of 14-gauge stainless steel complete with stainless steel finished ends and back. Provide accessible work area as shown.

- A. Top to be 14-gauge stainless steel complete with 2" turn downs on 4 sides and a working height of 2'-10".
- B. Base section to be 16-gauge stainless steel formed metal construction complete with 16-gauge stainless steel bottom and mid shelves. Provide accessible work area as shown.
- C. Provide 1 5/8" dia. Stainless steel tube legs with Component Hardware Group, Inc. A10-0851 adjustable foot insert.
- D. Provide (2) Component Hardware Group, Inc., model No. R58-1020 double-faced pedestal type electrical outlets with model No. R71-0721 stainless steel face plates. All electrical outlets to be provided with empty conduit all interconnected to one point connection at end of counter.
- E. Item(s) to be included as part of this are item(s) - #22.
- F. Provide adjustable seismic flanged feet. Refer to drawings for configuration and quantity.

ITEM #26 WOK TABLE

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following:

- A. Work area top to be 14-gauge stainless steel with a 14-gauge stainless steel backsplash at back 2" thick with a 45-degree top edge to wall, turn down 1/2" at back.

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- B. Top to be constructed with square edge 2" turn down at front edge with 1" return back.
- C. Legs to be 16-gauge stainless steel tubular, stainless steel welded leg sockets, stainless steel adjustable feet and stainless-steel cross rail bracing. Provide 16-gauge stainless steel under shelf as shown.
- D. Approximate size: 30" deep x Length as shown.

ITEM #26.1 WALL SHELF

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following:

- A. To be 16-gauge stainless steel construction, 1 1/2" turn down in front and 2" turn up at back and right end and left ends. Provide 14-gauge stainless steel wall brackets as shown. Shelf to be stud welded with cap nuts (2) ea at each shelf bracket silicone shelf to brackets will not be allowed for attachment.
- B. Approximate Size: (1) ea. 12" deep x length as shown.

ITEM #27 HAND SINK

Quantity: Two (2)

Manufacturer: Eagle Group (or equal)

Model: HSA-10-F

Status: CFCI

Hand Sink, wall mount, 13-1/2" wide x 9-3/4" front-to-back x 6-3/4" deep bowl, 304 stainless steel construction, splash mount gooseneck faucet, basket drain, deep-drawn seamless design-positive drain, inverted "V" edge, NSF

Accessories:

- 2ea. Standard Gooseneck Faucet, with wrist handles, splash-mounted, 4" OC
- 2ea. Drain Assembly, 1-1/2", for underbar sinks, fits 2" dia. hole, for HSA models (NOTE: not to be used with units containing 7-circuit post-mix cold plate)
- 2ea. Crumb Cup Strainer Assembly, with 1-1/2" outlet
- 2ea. Tail Piece, for 1-1/2 IPS connection, nickel-plated
- 2ea. P-Trap, nickel-plated
- 2ea. Paper Towel Dispenser, wall mounted, folded towel dispenser, 304 stainless steel construction
- 2ea. Soap Dispenser, deck mounted, 16 oz

ITEM #28 SHELVING UNIT, PLASTIC WITH POLY EXTERIOR STEEL POSTS

Quantity: Five (5)

Manufacturer: Cambro (or equal)

Model: CPMU244867V4480

AMD FOODSERVICE DESIGN
31860710000

FOODSERVICE EQUIPMENT
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Status: CFCI

Camshelving® Premium Mobile Starter Unit, 24"W x 48"L x 67"H, 4-tier, withstands temperature -36°F (-38°C) to 190°F (88°C), includes: (4) vented polypropylene shelf plates with Camguard® antimicrobial protection, (2) pre-assembled post kits (posts constructed of steel with polypropylene exterior), (8) traverses, molded-in dovetails, (2) sets of post connectors, (4) premium swivel casters with total locking brake, 750 lbs. max capacity, speckled gray, NSF

ITEM #29 FLOOR TROUGH

Quantity: One (1)

Manufacturer: Eagle Group (or equal)

Model: FT-1836-SG

Status: CFCI

Floor Trough, 36"W x 18"D, stainless steel subway-style grating, 4" deep trough pan with built-in pitch toward drain, accommodates up to 4" drain pipe, stainless steel removable perforated basket, 1" outer flange for mounting, all-welded 14/304 stainless steel construction, NSF

Accessories:

1ea. ADA-compliant grating

ITEM #30 UNIVERSAL PAN RACK

Quantity: Three (3)

Manufacturer: Eagle Group (or equal)

Model: 4339

Status: CFCI

Lifetime Series Bun Pan Rack, universal, 21-1/2" x 26" x 73"H, (20) 18" x 26" or (19) 12" x 20" pan capacity, (40) 13" x 18" pan capacity or (40) 14" x 18" tray capacity, slides on 3" centers, fully welded aluminum construction, (4) 6" x 2" non-marking swivel plate casters, NSF

ITEM #31 THREE DOOR REACH- IN FREEZER

Quantity: Two (2)

Manufacturer:

Model:

Status: OFCI

This item is existing and is to be reused. Contractor to verify utility and anchorage requirements with on-site conditions and DSA-approved documents.

ITEM #32 MOBILE WARMING CABINETS

Quantity: Four (4)

Manufacturer:

Model:

Status: OFCI

This item is existing and is to be reused. Contractor to verify utility and anchorage requirements with on-site conditions and DSA-approved documents.

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Drawings show the utility and anchorage locations totaling 6

ITEM #33 DOUBLE STACK CONVECTION OVEN ELECTRIC

Quantity: Three (3)

Manufacturer:

Model:

Status: OFCI

This item is existing and is to be relocated. Contractor to verify utility and anchorage requirements with on-site conditions and DSA-approved documents.

ITEM #34 TILT SKILLET

Quantity: One (1)

Manufacturer:

Model:

Status: OFCI

This item is existing and is to be relocated. Contractor to verify utility and anchorage requirements with on-site conditions and DSA-approved documents. The contractor to coordinate and verify the location of floor trough poor pattern with owner-furnished equipment.

ITEM #35 ICE MAKER WITH BIN

Quantity: One (1)

Manufacturer:

Model:

Status: OFCI

This item is existing and is to be remain. Contractor to verify utility and anchorage requirements with on-site conditions and DSA-approved documents. Drain to be routed to floor sink and indirectly drain.

ITEM #36 DISHTABLE SORTING SHELF

Quantity: One (1)

Manufacturer: Advance Tabco (or equal)

Model: DT-6R-60

Status: CFCI

Drainage Shelf, wall mount, tubular design, 60"W x 15"D x 8"H, stainless steel, KD

ITEM #37 DISHTABLE SORTING SHELF

Quantity: One (1)

Manufacturer: Advance Tabco (or equal)

Model: DT-6R-48

Status: CFCI

Drainage Shelf, wall mount, tubular design, 48"W x 15"D x 8"H, stainless steel, KD

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ITEM #38 WALL SHELF

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following:

- A. To be 16-gauge stainless steel construction, 1 1/2" turn down in front and 2" turn up at back and right end and left ends. Provide 14-gauge stainless steel wall brackets as shown. Shelf to be stud welded with cap nuts (2) ea at each shelf bracket silicone shelf to brackets will not be allowed for attachment.
- B. Approximate Size: (1) ea. 12" deep x length as shown.

ITEM #39 SINK, (3) THREE COMPARTMENT

Quantity: One (1)

Manufacturer: American Stainless-Steel Corp. (or equal)

Model: FABRICATED ITEM

Status: CFCI

Fabricated assembly in length and configuration as shown on the drawings and shall include the following:

- A. Work area top to be 14-gauge stainless steel with a 14-gauge stainless steel backsplash at back 2" thick with a 45-degree top edge to wall, turn down 1/2" at back to Z-clips. Top to be constructed with a rolled edge as shown. Drainboards are to slope per NSF guidelines to sinks.
- B. Three (3) 14-gauge stainless steel formed and welded integral sinks, refer to drawings for bowl dimensional requirements. (Diecast sink bows are not acceptable).
- C. Provide and install 16-gauge stainless steel tubular legs, stainless steel welded leg sockets, and stainless-steel cross rail bracing.
- D. Provide 16-gauge stainless steel undershelf with 1 1/2" turn down at front and 2" turn up at back.
- E. Provide adjustable seismic flanged feet. Refer to drawings for configuration and quantity.
- F. Twist waste valve to have support bracket installed as part of fabrication with a minimum of 4" clearance from twist handle.

Accessories:

- 3 ea. Fisher Model 22209 DrainKing Waste Valve, with flat strainer, 12 GPM drain rate, dual Teflon seals, stainless steel ball, cast red brass body
- 2 ea. T&S Brass Model B-0290-04 Big-Flo Mixing Faucet, wall mount, 8" adjustable centers, 12" swing nozzle with plain end outlet, 4" wrist handles with color coded indexes, low-lead, 3/4" female NPT, ANSI, NSF, ADA Compliant

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- 4ea. T&S Brass Model B-0427 Supply Nipple, 3/4" x 2-1/2"
T&S Brass Order in quantities of (2) per faucet
- 2 ea. T&S Brass Model B-0290-K Big-Flo Repair Kit, washers, o-rings, seats & screws

ITEM #40 PRE-RINSE FAUCET ASSEMBLY

Quantity: One (1)

Manufacturer: T&S Brass (or equal)

Model: B-0133

Status: CFCI

EasyInstall Pre-Rinse Unit, wall mount mixing faucet with 8" adjustable centers, quarter-turn Eterna cartridges with spring checks, lever handles with color-coded indexes, 18" EasyInstall riser, 44" flexible stainless steel hose with heat-resistant gray handle & hold down ring, 1.15 GPM spray valve (B-0107), finger hook, polished chrome-plated brass faucet body, 1/2" NPT female inlets, CSA

Accessories:

- 1ea. Contact factory for options and accessories
- 1ea. Replacement Hex Swivel, low-lead, rubber seals, chrome-plated brass, 7/8" NPT, NSF (for pre-rinse hose & spray valves)
- 1ea. EasyInstall Tee Assembly, chrome-plated
- 1ea. Tee Assembly, rigid, chrome-plated
- 1ea. Wall Bracket, 6"
- 1ea. Installation Kit, (2) 1/2" NPT nipples, lock nuts & washers, (2) short "EII" 1/2" NPT female x male
- 1ea. Inlet Kit, 1/2" NPT nipple, close elbows, 24" flex supply hoses

END OF SECTION

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SECTION 12 36 00 - COUNTERTOPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Solid surfacing countertops.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
 2. Show locations and sizes of cutouts and holes for items installed in countertops.
 3. Apply WI Monitored Compliance Program label to Shop Drawings.
- C. Samples for Verification: As follows:
1. Countertops: For each type, color, pattern, and surface finish required, 8 by 10 inches in size.
 2. Fabrication Sample: For each type and profile of countertop required, provide one sample applied to core material with specified edge material applied to one edge.

1.03 INFORMATIONAL SUBMITTALS

- A. Quality Standard Compliance Certificates: WI Monitored Compliance Program.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Materials, components, assemblies, workmanship and installation are to be observed by the Owner's Project Inspector. Work not so inspected is subject to uncovering and replacement.
- C. Mockups:

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1. Provide solid surfacing countertop for casework mockup where selected by Architect.
- D. Quality Standard: Unless otherwise indicated, comply with WI's North American Architectural Woodwork Standards (NAAWS) for grades indicated for construction, finishes, installation, and other requirements.
1. Provide WI-Monitored compliance labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.
 2. Where the Contract Documents contain requirements that are more stringent than the referenced quality standard, comply with requirements of the Contract Documents in addition to those of the referenced quality standard.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Do not deliver products until wet work, painting, and similar operations in storage and installation areas that could damage or soil work have been completed.
 - B. Deliver undamaged products to job in manufacturer's sealed containers and/or original bundles with tags and labels intact.
 - C. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.
 - D. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
 - E. Keep surfaces of countertops covered with protective covering during handling and installation.
- 1.07 FIELD CONDITIONS
- A. Environmental Limitations without Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
 - B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- 1.08 WARRANTY
- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace countertops that fail in materials or workmanship within specified warranty period.
 1. Warranty Period:
 - a. Solid Surfacing Material: 10 years from date of Substantial Completion.

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- B. Special Installer's Warranty: Signed by Installer, covering Work of this Section, for warranty period of two years.
 - 1. Warranty includes removing and reinstalling solid surfacing countertops, end and back splashes, plumbing fixtures and other items integral to the installation.

PART 2 - PRODUCTS

2.01 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Basis-of-Design Products: As indicated on Drawings.
 - 2. Type: Provide Standard type unless Special Purpose type is indicated.
 - 3. Colors and Patterns: As indicated by manufacturer's designations.

2.02 ACCESSORIES

- A. Concealed Countertop Brackets: A&M Concealed Brackets as manufactured by A&M Hardware, Inc. or equal.
 - 1. Size brace appropriate with size of countertop.
 - 2. Color: As selected by Architect from full range of manufacturer's standard colors. Multiple colors may be selected.
- B. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Outside Diameter: 2 inches.
 - 2. Color: As selected by Architect from manufacturer's full range,

2.03 SOLID SURFACING COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the WI's "North American Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Configuration: As indicated on drawings.
- C. Backsplashes: 1/2-inch- thick, solid surface material.
- D. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- E. Joints: Fabricate countertops without joints.

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PART 3 - EXECUTION

3.01 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.02 SOLID SURFACING COUNTERTOP INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Install countertops conforming to manufacturer's recommended installation procedures and as required to effect the specified manufacturer warranty.
 - 1. Set tops on supports.
 - 2. Anchor using fasteners shown on reviewed shop drawings.
- 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. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Pre-drill holes for screws as recommended by manufacturer.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- H. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

3.03 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

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- B. Clean countertops on exposed and semiexposed surfaces.
- C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION

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SECTION 12 36 16 - METAL COUNTERTOPS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Stainless-steel countertops.
2. Stainless-steel wall-mounted shelves.

B. Related Sections:

1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded wall-mounted shelves.

1.03 ACTION SUBMITTALS

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

B. Shop Drawings: For metal fabrications.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. For countertops, show locations and sizes of cutouts and holes for items installed in metal countertops.
3. For wall-mounted shelves, indicate requirements for blocking or reinforcements in supporting construction.

1.04 INFORMATIONAL SUBMITTALS

A. Sustainable Design Submittals:

1. Documentation for sealants, indicating VOC content.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products only after casework and supports on which they will be installed has been completed in installation areas.

- B. Keep finished surfaces of products covered with polyethylene film or other protective covering during handling and installation.

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1.06 FIELD CONDITIONS

- A. Field Measurements: Where products are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
1. Sealants:
 - a. VOC content limits for field applications.

2.02 STAINLESS-STEEL FABRICATIONS

- A. Countertops: Fabricate from 0.062-inch- thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 inch over the base cabinets.
1. Joints: Fabricate countertops without field-made joints.
 2. Weld shop-made joints.
 3. Sound deaden the undersurface with heavy-build mastic coating.
 4. Extend the top down to provide a 1-inch- thick edge with a 1/2-inch return flange.
 5. Form the backsplash coved to and integral with top surface, with a 1/2-inch- thick top edge and 1/2-inch return flange.
 6. Provide raised (marine) edge around perimeter of tops containing sinks; pitch tops containing sinks two ways to provide drainage without channeling or grooving.
- B. Wall-Mounted Shelves: Fabricate from stainless-steel sheet, not less than 0.050-inch nominal thickness. Weld shop-made joints. Fold front edge down a minimum of 3/4 inch; fold back edge up a minimum of 3 inches. Provide integral stiffening brackets, formed by folding up ends a minimum of 3/4 inch and by welding to upturned edges.

2.03 MATERIALS

- A. Stainless-Steel Sheet: ASTM A240/A240M, Type 304.
- B. Sealant for Countertops: Manufacturer's standard sealant that complies with applicable requirements in Section 07 92 00 "Joint Sealants" and the following:
1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone.
 2. Color: Clear.

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2.04 STAINLESS-STEEL FINISH

- A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.
- B. Secure countertops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.
- C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- D. Seal junctures of countertops, splashes, and walls with sealant for countertops.
- E. Wall-Mounted Shelves: Fasten to supporting construction through upturned back edge at not less than 24 inches o.c.
 - 1. For framed construction, fasten through wall or partition finishes directly to framing, blocking, or reinforcements.

3.03 CLEANING AND PROTECTION

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces. Remove and replace damaged products or touch up and refinish damaged areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

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SECTION 12 52 19 - UPHOLSTERED SEATING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Upholstered seating cushions.

1.02 SUBMITTALS

- A. Product Data.
- B. Verification Samples: Show full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the Work.
1. Upholstery Fabric: Full-width by 36-inch- long section of material from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.
- C. Maintenance Data: For custom upholstered seating to include in maintenance manuals specified in Division 01. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.

1.03 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
1. Fabric and Padding:
 - a. Fabric: Class 1 according to DOC CS 191 or 16 CFR 1610, tested according to California Technical Bulletin 117.
 - b. Padding: Comply with California Technical Bulletin 117.
 2. Upholstery Assembly: Assembly shall comply with component-testing requirements of California Technical Bulletin 117.

1.04 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fixed audience seating that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Wear and deterioration of fabric and stitching beyond normal use.
 2. Warranty Period: Five years, from date of Substantial Completion.

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PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain each type of seating required from single source from single manufacturer.
 - 1. Upholstery Fabric: Obtain fabric of a single dye lot for each color and pattern of fabric required.

2.02 MATERIALS

- A. Upholstery Fabric: Manufacturer's standard; with flame-retardant treatment if required to meet performance requirements.
 - 1. Basis-of-Design Product: As indicated on Drawings.
 - 2. Color and Pattern: As indicated by manufacturer's designations.
- B. Upholstery Padding: Flexible, cellular, molded or slab polyurethane foam.
 - 1. Pounding-Fatigue Performance: Grade AP (heavy-duty use) for seats and Grade BP (normal duty use) for backs; according to ASTM D3453.

2.03 FABRICATION

- A. Double stitch seams.
- B. Center upholstery pattern indicated on the inside and outside seatback and cushion, and in the same location on each seating unit. Match upholstery pattern on cushion and upholstered seat edge.
- C. Apply upholstery material smooth and even, with undistorted grain lines, and free of ripples, scallops, or puckers.
- D. Conceal channeled seams. Channel stitch straight and continuous, with channels parallel to each other and perpendicular to intersecting materials.
- E. Staple or sew breathable concealment fabric to underneath side of seat. Secure staples flush with seating frame to prevent snagging concealment fabric.
- F. Fabricate removable seat cushion covers with cushion vents and concealed zippers.
- G. Fabricate seat cushions and seat frame with integral, concealed, hook-type fasteners to secure cushions in place.
- H. Fabricate arm pad covers and upholstered arms to match upholstery material pattern placement on seat arm. Include integral, concealed, hook-type fasteners to secure arm pad covers in place.

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- I. Cut welt-cord cover on bias.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install seating units level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- B. Anchor seating units to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.

3.02 ADJUSTING AND CLEANING

- A. Repair damaged and defective seating units where possible, to eliminate functional and visual defects. Where not possible to repair, replace seating units.

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SECTION 22 00 50 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Electric motors.
2. Motor starters.
3. Strainers.
4. Valve boxes.
5. Gauges.
6. Thermometers.
7. Access Doors.
8. Expansion loops.
9. Flexible joints.
10. Insulation.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This Section is a part of each Division 22 Section.

1.03 ADDITIONAL REQUIREMENTS

- A. Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.
- B. Make all temporary connections required to maintain services during the course of this Contract without additional cost to the Owner. Notify the Owner seven days in advance before disturbing any service.
- C. Plumbing work done under this contract shall not adversely affect the operation of the existing plumbing systems.

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1.04 REFERENCES AND STANDARDS

A. Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at the time of bid shall be used.

1. CSA – Canadian Standards Association International.
2. ANSI - American National Standards Institute.
3. ASTM - American Society for Testing and Materials.
4. CCR - California Code of Regulations.
 - a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36.
5. NCPWB - National Certified Pipe Welding Bureau.
6. CEC - California Electrical Code.
7. NEMA - National Electrical Manufacturers' Association.
8. NFPA - National Fire Protection Association.
9. OSHA - Occupational Safety and Health Act.
10. UL - Underwriters' Laboratories, Inc.

B. Requirements of Regulatory Agencies:

1. The publications listed below form part of this specification; comply with provisions of these publications except as otherwise shown or specified.
 - a. California Building Code, 2022.
 - b. California Electrical Code, 2022.
 - c. California Energy Code, 2022.
 - d. California Fire Code, 2022.
 - e. California Green Building Standards Code, 2022.
 - f. California Mechanical Code, 2022.
 - g. California Plumbing Code, 2022.
 - h. California Code of Regulations, Title 24.

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- i. California Health and Safety Code.
 - j. CAL-OSHA.
 - k. California State Fire Marshal, Title 19 CCR.
 - l. National Fire Protection Association.
 - m. Occupational Safety and Health Administration.
 - n. Other applicable state laws.
2. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or specifications to repeat requirements of codes except where necessary for clarity.

1.05 DRAWINGS

- A. Examine Contract Documents prior to bidding of work and report discrepancies in writing to Architect.
- B. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The Plumbing Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.
 1. Architectural and Structural Drawings shall be considered part of the Work. These Drawings furnish Contractor with information relating to design and construction of the Project. Architectural Drawings take precedence over Plumbing Drawings.
 2. Because of the small scale of Plumbing Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and arrange Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in the locations shown. Obtain the Architects approval prior to relocation of equipment and materials.
 3. Relocate equipment and materials installed without prior approval of the Architect. Remove and relocate equipment and materials at Contractors' expense upon Architects' direction.

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4. Minor changes in locations of equipment, piping, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.
- C. Execute work mentioned in Specifications and not shown on Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.06 FEES AND PERMITS

- A. Obtain and pay for all permits and service required in installation of this work; arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with requirements of Division 01.
- B. Arrange for utility connections and pay charges incurred, including excess service charges.
1. Bear the cost of construction related to utility services, from point of connection to utility services shown on Contract Documents. This includes piping, excavation, backfill, meters, boxes, check valves, backflow prevention devices, general service valves, concrete work, and the like, whether or not Work is performed by Contractor, local water/sanitation district, public utility, other governmental agencies or agencies' assigns.
- C. Prior to the start of construction, contact local gas company representative and coordinate location of gas meter and piping. In addition, coordinate time required for installation, in order to avoid delay to the Project.
- D. Coordination:
1. General:
 - a. Coordinate plumbing Work with trades covered in other Specifications Sections to provide a complete, operable and sanitary installation of the highest quality workmanship.
 2. Electrical Coordination:
 - a. Refer to the Electrical Drawings and Specifications, Division 26, for service voltage and power feed wiring for equipment specified under this section. Contractor has full responsibility for the following items of work:

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- 1) Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
 - 2) If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include cost to furnish and install additional electrical services as part of the bid.
 - 3) Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.
3. Mechanical Coordination:
- a. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
 - b. Coordinate installation of supporting devices. Set sleeves in poured-in-place concrete and other structural components during progress of construction.
 - c. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
 - d. Coordinate with other trades equipment locations, pipe, duct and conduit runs, electrical outlets and fixtures, air inlets and outlets, and structural and architectural features. Provide information on location of piping and seismic bracing to other trades as required for a completely coordinated project.

1.07 SUBMITTALS - GENERAL

- A. Refer to Division 01 Submittals Section(s) for additional requirements.
- B. Submittal packages may be submitted via email as PDF electronic files, or as printed packages. PDFs shall be legible at actual size (100 percent). Provide seven copies of printed submittal packages.
- C. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality.

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Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used.

1. Partial or incomplete submittals will not be considered.
 2. Quantities are Contractor's responsibility and will not be reviewed.
 3. Provide materials of the same brand or manufacturer for each class of equipment or material.
 4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.
 5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.
 6. Organize submittals in same sequence as in Specification Sections.
 7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
 - a. Submit Shop Drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.
 - b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.
 - c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.
 - d. Catalog cuts and published material may be included with supplemental scaled drawings.
- D. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or

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construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.

- E. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect Shop Drawings or submittals on all items of equipment and materials provided. Provide submittal in at least seven copies and in complete package.
 - 1. Shop Drawings and submittals shall include Specification Section, Paragraph number, and Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from the Contract Documents shall be prominently displayed in the front of the submittal package and referenced to the applicable Contract requirement.
- F. Furnish to the Project Inspector complete installation instructions on material and equipment before starting installation.

1.08 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for plumbing systems materials and products.
- B. Shop Drawings.
- C. Sustainable Design Submittals:
 - 1. Product Data: For adhesives and sealants, documentation of compliance including printed statement of VOC content and chemical components.]
 - 2. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.]
- D. Pipe, pipe or plumbing fittings, fixtures, solder and flux installed in a system providing water for human consumption shall comply with lead free requirements of the California Health and Safety Code Section 11 68 75. Provide submittal information for products third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.
- E. Delegated-Design Submittals: For seismic supports, anchorages, restraints, and vibration isolators indicated to comply with performance requirements and design criteria.

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1. Calculations performed for use in selection of seismic supports, anchorages, and restraints shall utilize criteria indicated in Structural Contract Documents.
2. Include design calculations and details for selecting vibration isolators and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the California registered structural engineer responsible for their preparation.
3. Supports, anchorages and restraints for piping, ductwork, and equipment shall be an HCAI pre-approved system such as TOLCO, ISAT, Mason, or equal. Pipes, ducts and equipment shall be seismically restrained in accordance with requirements of current edition of California Building Code. System shall have current OPM number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping, ductwork and restraint locations.
 - a. Bracing of Piping and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation. Gas pipe bracing shall be designed in accordance with California Building Code Section 1615A.1.22 and ASCE 7-10 Section 13.6. Coefficient $I_p = 1.5$ shall be used for gas piping bracing calculations.
 - b. In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, ductwork, and restraint locations, and detail supports, attachments and restraints, and furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with 2016 California Building Code
4. Additional Requirements: In addition to the above, conform to all state and local requirements.

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1.09 INFORMATIONAL SUBMITTALS

- A. Provide layouts for plumbing systems, for inclusion in coordinated layout specified in Section 23 80 00. Comply with requirements for layouts specified in Section 23 80 00.

1.10 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Refer to Division 01 for complete instructions.
2. Furnish three complete sets of Operation and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operation and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Begin compiling data upon approval of submittals.
 - a. Sets shall incorporate the following:
 - 1) Product Data.
 - 2) Shop Drawings.
 - 3) Record Drawings.
 - 4) Service telephone number, address and contact person for each category of equipment or system.
 - 5) Complete operating and maintenance instructions for each item of plumbing equipment and systems.
 - 6) Copies of guarantees/warrantees for each item of equipment and systems.
 - 7) Test data and system balancing reports.
 - 8) Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
 - 9) Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
 - 10) Control diagrams and literature.

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- 11) A complete list or schedule of all scheduled valves giving the number of the valve, location and the rooms or area controlled by the valve. Identify each valve with a permanently attached metal tag stamped with number to match schedule. Post list in frame under plastic on wall in mechanical room or where directed by Architect.
 - 12) Check test and start reports for each piece of plumbing equipment provided as part of the Work.
 - 13) Commissioning and Preliminary Operation Tests required as part of the Work.
- b. Post service telephone numbers and/or addresses in an appropriate place as designated by the Architect.

B. Record Drawings:

1. Refer to Division 01, Record Documents, for requirements governing Work specified herein.
2. Upon completion of the work, deliver to Architect the following:
 - a. Originals of drawings showing the Work exactly as installed.
 - b. One complete set of reproducible drawings showing the Work exactly as installed.
 - c. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
 - d. Provide Contractor's signature, verifying accuracy of record drawings.
 - e. Obtain the signature of the Project Inspector for all record drawings.

1.11 SUBSTITUTIONS

- A. Refer to Division 01 for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In the case of conflict between requirements given herein and those of Division 01, Division 01 requirements shall apply.
- B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.

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- C. Substitutions will be interpreted to be all manufacturers other than those specifically listed in the Contract Documents by brand name, model or catalog number.
- D. Only one request for substitution will be considered for each item of equipment or material.
- E. Substitution requests shall include the following:
 - 1. Reason for substitution request.
 - 2. Complete submittal information as described herein; see "Submittals."
 - 3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
 - 4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.
 - 5. Explanation of impact on connected utilities.
 - 6. Explanation of impact on structural supports.
- F. Installation of reviewed substitution is the Contractors' responsibility. Any mechanical, electrical, structural, or other changes required for installation of reviewed substituted equipment or material must be made by the Contractor without additional cost to the Owner. Review by the Architect of the substituted equipment or material, including dimensioned Drawings will not waive these requirements.
- G. Contractor may be required to compensate the Architect for costs related to substituted equipment or material.

1.12 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with plumbing systems work similar to that required for this Project.

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- C. California Health and Safety Code Compliance: For products covered under the scope of HSC 116875 for potable water service. Products for potable water service shall be third-party certified by an approved laboratory as complying with California Health and Safety Code Section 11 68 75.
- D. Comply with applicable portions of California Plumbing Code pertaining to selection and installation of plumbing materials and products.
- E. All materials and products shall be new and shall match existing.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment and piping delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

1.14 FIELD CONDITIONS

- A. Contractor shall visit Project site and examine existing conditions in order to become familiar with Project scope. Verify dimensions shown on Drawings at Project site. Bring discrepancies to the attention of Architect. Failure to examine Project site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that affect Project scope.
- B. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by the Architect and shall be made without additional cost to the Owner. The Contractor shall be held responsible for damage caused to existing services. Promptly notify the Architect if services are found which are not shown on Drawings.

1.15 WARRANTY

- A. Refer to Division 01 for warranty requirements, and duration and effective date of Contractor's Standard Guarantee.
- B. Repair or replace defective work, material, or part that appears within the warranty period, including damage caused by leaks.
- C. On failure to comply with the warranty requirements within a reasonable length of time after notification is given, the Architect/Owner shall have the repairs made at the Contractor's expense.

1.16 REFERENCE STANDARDS

- A. ASCE 7-10 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2010.

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- B. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- D. NEMA MG 1 - Motors and Generators; 2021.

PART 2 PRODUCTS

2.01 GENERAL

- A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.
- B. All sizes, capacities, and efficiency ratings shown are minimum, except that gas capacity is maximum available.
- C. Refer to Sections 22 10 00 and 23 80 00 for specific system piping materials.

2.02 MATERIALS AND PRODUCTS

- A. No material installed as part of this Work shall contain asbestos.
- B. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

2.03 ELECTRIC MOTORS

- A. General Motor Requirements: Comply with NEMA MG 1 unless otherwise indicated. Comply with IEEE 841 for severe-duty motors.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. U.S. Motors.
 - b. Century Electric.
 - c. General Electric.
 - d. Lincoln.
 - e. Gould.

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- B. Motor Characteristics: Designed for continuous duty at ambient temperature of 40 deg. C and at altitude of 3300 feet above sea level. Capacity and torque shall be sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
1. Motors exceeding the nameplate amperage shall be promptly replaced at no cost to the Owner. Horsepower shown is minimum and shall be increased as necessary to comply with above requirements. Furnish motors with splash-proof or weatherproof housings, where required or recommended by the manufacturer. Match the nameplate voltage rating with the electrical service supplied. Check Electrical Drawings. Provide a transformer for each motor not wound specifically for system voltage.
- C. Polyphase Motors: NEMA MG 1, Design B, medium induction motor, premium efficiency as defined in NEMA MG 1. Select motors with service factor of 1.15. Provide motor with random-wound, squirrel cage rotor, and permanently lubricated or regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading. Temperature rise shall match insulation rating. Provide Class F insulation.
1. Multispeed motors shall have separate windings for each speed.
- D. Polyphase Motors with Additional Requirements:
1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
 2. Motors Used with Variable Frequency Controllers:
 - a. Separately Connected Motors: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - b. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - c. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - d. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

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- e. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - f. Each motor shall be provided with a shaft grounding device for stray current protection.
3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
- E. Single-Phase Motors:
- 1. Select motors with service factor of 1.15.
 - 2. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
 - 3. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
 - 4. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
 - 5. Motors 1/20 HP and Smaller: Shaded-pole type.
- F. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.04 MOTOR STARTERS

- A. Square D, Allen Bradley, or equal, in NEMA Type 1 enclosure, unless otherwise specified or required. Minimum starter size shall be Size 1. Provide NEMA 3R enclosure where exposed to outdoors.
- B. Provide magnetic motor starters for equipment provided under the Mechanical Work. Starters shall be non-combination type. Provide part winding or reduced voltage start motors where shown or as hereinafter specified. Minimum size starter shall be Size 1.

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1. All starters shall have the following:
 - a. Cover mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.
 - b. Ambient compensated thermal overload.
 - c. Fused control transformer (for 120 or 24 volt service).
 - d. Pilot lights, integral with the starters. Starters located outdoors shall be in NEMA IIIIR enclosures.
2. Where three phase motors are provided for two-speed operation, provide two speed motor starters.
3. Starters for single-phase motors shall have thermal overloads. NEMA I enclosure for starters located indoors, NEMA IIIIR enclosure for starters located outdoors.
4. Provide OSHA label indicating the device starts automatically.

2.05 STRAINERS FOR POTABLE WATER SYSTEMS

- A. Strainers: Full line size, conforming to lead-free requirements of California Health and safety Code Section 11 68 75. "Y" pattern, 125 psi SWP minimum, with 304 stainless steel screens. Install all strainers with a blow-off hose valve with hose adapter. Strainer shall have gasketed cover with straight thread.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. 3 inches and smaller: bronze or brass body, threaded ends, with 20 mesh screen. Watts LF777SI, Wilkins SXL.
 - b. 4 inches and larger: Cast iron body, flanged ends, 1/16 inch or 1/8 inch screen as normally supplied for each size. Watts 77F-DI-125, Mueller 758.

2.06 STRAINERS FOR NON-POTABLE WATER SYSTEMS

- A. Charles M. Bailey #100A, Armstrong, Muessco, or equal, Fig. 11 "Y" pattern, 125 psi WP minimum, with monel screens with 20 square mesh for 2 inches and smaller and 3/64 inch perforations for 2-1/2 inches and larger. Install all strainers with a blow-off hose valve with hose adapter. Strainer shall have gasketed cover with straight thread.

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2.07 VALVE BOXES

- A. General:
1. Where several valves or other equipment are grouped together, provide larger boxes of rectangular "vault" type adequately sized for condition and similar in construction to those specified above.
 2. Provide valve box extensions as required to set bottom of valve box tight up to top of piping in which valve is installed.
 3. Provide a tee handle wrench for each size, Alhambra Foundry Co. #A-3008, or equal.
- B. Valve Boxes in Traffic Areas: Provide Christy No. G5 traffic valve box, Brooks, or equal, 10-3/8 inches inside diameter with extensions to suit conditions, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves.
- C. Valve Boxes in Non-Traffic Areas: Provide Christy No. F22, Brooks, or equal, 8 inches inside diameter by 30 inches long, with cast iron or steel locking cover. Provide Owner with set of special wrenches or tools as required for operation of valves. Cut bottom of plastic body for operation of valves.
- D. Valve Box (Rectangular Vault Type): Precast concrete or cast iron with cast iron or steel locking type covers lettered to suit service – Brooks No. 3-TL, Christy No. B3, Fraser No. 3, Alhambra A-3004 or A-3005, Alhambra E-2202, or E-2702, or equal, with extension to suit conditions.

2.08 GAUGES

- A. Marsh "Series J", U.S. Gage, Danton 800, or equal, with bronze bushed movement and front recalibration. Dials shall be white with black numerals, 3-1/2 inch dial face. Normal reading shall be at mid-scale. Provide a needle valve on each gauge connection. Supply a gauge piped with branch isolation valves across the inlet and outlet of each pump and where shown on the Drawings.
- B. Provide Pete's Plug II, Sisco P/T, or equal, test plug with Nordel core {and gasketed cap}, on inlet and outlet of each coil, boiler, condenser, chiller and heat exchanger and where shown on Drawings.

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2.09 THERMOMETERS

- A. Marsh, Taylor, Palmer, or equal, 5 inch diameter bimetal dial, adjustable from face, with adjustable positioner, located to be easily read from normal personnel approach. Normal reading shall be at mid-scale.
 - 1. Provide extension for insulation.
 - 2. Provide thermometers with steel bulb chambers and brass separable sockets.
- B. Provide Pete's Plug II, Sisco P/T, or equal, test plug with Nordel core, on inlet and outlet of each coil, boiler, and heat exchanger and provide two digital electronic test thermometers for each range of fluid temperature and where shown on Drawings.

2.10 ACCESS DOORS

- A. Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.
 - 1. All access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.
- B. Access doors shall match those supplied in Division 08 in all respects, except as noted herein.
- C. Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for all other areas.
- D. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the Architect when access is required in these areas.
- E. Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.
- F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:

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1. Milcor
 - a. Style K (plaster).
 - b. Style DW (gypsum board).
 - c. Style M (Masonry).
 - d. Style "Fire Rated" where required.

2.11 THERMAL AND SEISMIC EXPANSION LOOPS

- A. Manufactured assembly consisting of inlet and outlet elbow fittings, two sections of flexible metal hose and braid, and 180-degree return bend. Return bend section shall have support lug and plugged FPT drain. Flexible hose shall consist of corrugated metal inner hose and braided metal outer sheath. Assemblies shall be constructed from materials compatible with the fluid or gas being conveyed and shall be suitable for the system operating pressure and temperature. Provide assembly selected for 4 inches of movement.
- B. Provide CSA certified expansion loops for use in natural or propane gas piping systems.
- C. Where used in potable water systems, provide expansion loops of certified lead-free construction.
- D. Basis-of-Design Product: Subject to compliance with requirements, provide Metraflex Inc., Metraloop series, or comparable product by one of the following, or equal:
 1. Flexicraft Industries.

2.12 FLEXIBLE JOINTS

- A. Where indicated on Drawings, provide Metraflex Metrasphere, Style R, Mason Industries, or equal, Spherical Expansion Joints. Provide control units at each expansion joint, arranged to limit both expansion and compression.
- B. Flexible joints at entry points to building shall be Barco Ductile iron, Advanced Thermal Systems, or equal, threaded style with stainless ball and mineral filled seal.

2.13 PIPE GUIDES

- A. Where flexible connections are indicated on Drawings, provide Metraflex style IV, B-Line, or equal, pipe guides in locations recommended by manufacturer.

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Maximum spacing from flexible connection to first pipe guide is 4 pipe diameters, and maximum spacing from second pipe guide is 14 pipe diameters.

2.14 EQUIPMENT IDENTIFICATION

- A. Identify each piece of equipment with a permanently attached engraved bakelite plate, 1/2 inch high white letters on black background.

2.15 PIPE IDENTIFICATION

- A. Identify each piping system and indicate the direction of flow by means of Seton, Inc., Marking Services Inc., Reef Industries, Inc., or equal, pre-tensioned, coiled semi-rigid plastic pipe labels formed to circumference of pipe, requiring no fasteners or adhesive for attachment to pipe.
- B. The legends and flow arrows shall conform to ASME A13.1.

2.16 INSULATION WORK

- A. General:
 - 1. For insulating domestic hot water pumps, refer to Section 22 50 00, Plumbing Equipment,
 - 2. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
 - 3. Adhesives and sealants shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
 - 4. The term "piping" used herein includes pipe, valves, strainers and fittings.
 - 5. Apply insulating cement to fittings, valves and strainers and trowel smooth to the thickness of adjacent covering. Cover with jacket to match piping. Extend covering on valves up to the bonnet. Leave strainer cleanout plugs accessible.
 - 6. Provide pre-formed PVC valve and fitting covers.
 - 7. Provide Calcium Silicate rigid insulation and sheet metal sleeve, 18 inch minimum length at each pipe hanger. Seal ends of insulation to make vapor tight with jacket.

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8. Test insulation, jackets and lap-seal adhesives as a composite product and confirm flame spread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with UL723 or ASTM E84.
9. Clean thoroughly, test and have approved, all piping and equipment before installing insulation and/or covering.
10. Repair all damage to existing pipe and equipment insulation whether or not caused during the work of this contract, to match existing adjacent insulation for thickness and finish, but conforming to flame spread and smoke ratings specified above.

B. Insulation of Piping:

1. Insulate domestic hot and tempered water with minimum 3-1/2 pounds per cubic foot density fiberglass with ASJ-SSL jacket. Insulation thickness shall be the following:
 - a. Pipe 3/4 inches and smaller: 1 inch thick.
 - b. Pipe 1 inch through 1-1/2 inches: 1-1/2 inches thick.
 - c. Pipe 2 inches and larger: 2 inches thick.
2. Insulate domestic hot water piping under slab on grade with Owens Corning Foamglas, preformed pipe insulation, or equal. Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Cover pipe and fittings with insulation manufacturer's recommended jacketing. Insulation thickness shall be the following:
 - a. Pipe 3/4 inches and smaller: 2 inches thick.
 - b. Pipe 1 inch and larger: 3 inches thick.
3. Insulate domestic cold water piping located within building, outside of insulation envelope in outside walls, vented attic spaces, and unheated spaces, including equipment rooms and below raised floor with 1 inch thick molded fiberglass, minimum 3-1/2 pound per cubic foot density, with ASJ-SSL jacket.
4. Insulate domestic cold water piping located outside building exposed to weather with minimum 3-1/2 pounds per cubic foot density fiberglass with ASJ-SSL jacket. Insulation thickness for all pipe sizes: 2 inches.

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5. Insulate roof drain and overflow drain bodies, horizontal sections of rainwater leader piping and overflow piping, and condensate drains within the building envelope with 1 inch thick fiberglass, minimum 3-1/2 pound per cubic foot density, with ASJ-SSL jacket.
6. Insulate condensate drain piping in freezer with 3/4 inch thick Therma-Cel, Armaflex, or equal. Seal water tight per manufacturer's directions. Install heat tape prior to insulation of piping, in accordance with manufacturer's directions.
7. Insulate electrically heat-traced grease waste piping under slab on grade with Owens Corning Foamglas, preformed pipe insulation, or equal. Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Cover pipe and fittings with insulation manufacturer's recommended jacketing. Insulation thickness for all pipe sizes: 3 inches.
8. Exposed insulated piping within the building shall have a Zeston 2000 25/50, Proto Lo-Smoke, or equal, PVC jacket and fitting cover installed over the insulation, applied per manufacturer's instructions. Insulation shall be vapor tight before applying PVC jacket and fitting covers. Verify suitability with manufacturer of insulation. Insulation with pre-applied polymer jacket may be substituted at Contractor's option.
9. Where insulated piping is exposed to the weather apply aluminum jacket secured with 1/2 inch stainless-steel bands on 12 inch centers. Insulation shall be vapor tight before applying metal jacket, and aluminum fitting covers. Install jacketing 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. Cover fittings with glass cloth, two coats of Foster Sealfas 30-36, and factory-fabricated aluminum fitting covers, of same material, finish, and thickness as jacket. Insulation shall be vapor tight before applying metal jacket and fitting covers.
 - a. Fitting covers:
 - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 2) Tee covers.
 - 3) Flange and union covers.

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- 4) End caps.
 - 5) Beveled collars.
 - 6) Valve covers.
 - 7) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- b. Jacket thickness:
- 1) Pipes 10 inches diameter and smaller: Minimum .016 inch thick jacket with smooth finish.
 - 2) Pipes 12 inches diameter and larger: Minimum .020 inch thick jacket with smooth finish.

PART 3 EXECUTION

3.01 EXISTING MATERIALS

- A. Remove existing equipment, piping, wiring, construction, etc., which interferes with Work of this Contract. Promptly return to service upon completion of work in the area. Replace items damaged by Contractor with new material to match existing.
- B. Removed materials which will not be re-installed and which are not claimed by Owner shall become property of Contractor and shall be removed from Project site. Consult Owner before removing any material from Project site. Carefully remove materials claimed by Owner to prevent damage and deliver to Owner-designated storage location.
- C. Existing piping and wiring not reused and are concealed in building construction may be abandoned in place and all ends shall be capped or plugged. Remove unused piping and wiring exposed in Equipment Rooms or occupied spaces. Material shall be removed from Project premises. Disconnect power, water, gas, pump or any other active energy source from piping or electrical service prior to abandoning in place.
- D. Existing piping, ductwork, and equipment modified or altered as part of this Work shall comply with the most recent applicable code requirements.

3.02 FRAMING, CUTTING AND PATCHING

- A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.

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- B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.
- C. Cutting, patching, and repairing of existing construction to permit installation of equipment, and materials is the responsibility of Contractor. Repair or replace damage to existing work with skilled mechanics for each trade.
- D. Cut existing concrete construction with a concrete saw. Do not utilize pneumatic devices.
- E. Core openings through existing construction for passage of new piping and conduits. Cut holes of minimum diameter to suit size of pipe and associated insulation installed. Coordinate with building structure, and obtain Structural Engineer's approval prior to coring through existing construction.

3.03 PLUMBING DEMOLITION

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

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3.04 ELECTRICAL REQUIREMENTS

- A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the Mechanical Work with the Electrical Work to comply.
- B. Furnish necessary control diagrams and instructions for the controls. Before permitting operation of any equipment which is furnished, installed, or modified under this Section, review all associated electrical work, including overload protection devices, and assume complete responsibility for the correctness of the electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. All equipment and connections exposed to the weather shall be NEMA IIR with factory-wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.
- C. All line voltage and low voltage wiring and conduit associated with the Temperature Control System are included in this Section. Wiring and conduit shall comply with Division 26.

3.05 PIPING SYSTEM REQUIREMENTS

- A. Drawing plans, schematic and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

3.06 PRIMING AND PAINTING

- A. Perform priming and painting on the equipment and materials as specified herein.
- B. See Division 09 Painting Section(s) for detailed requirements.
- C. Priming and Painting:
 - 1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed and painted.
 - a. Black Steel Piping:

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- 1) Primer: One coat gray Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, comparable products by Rust-Oleum, Kelly Moore, or equal.
 - 2) Topcoat: Two coats gray Sherwin-Williams Pro Industrial Waterbased Alkyd Urethane Enamel, comparable products by Rust-Oleum, Kelly Moore, or equal.
2. Metal surfaces of items to be jacketed or insulated except piping shall be given two coats of primer unless furnished with equivalent factory finish. Items to be primed shall be properly cleaned by effective means free of rust, dirt, scale, grease and other deleterious matter and then primed with the best available grade of zinc rich primer. After erection or installation, all primed surfaces shall be properly cleaned of any foreign or deleterious matter that might impair proper bonding of subsequent paint coatings. Any abrasion or other damage to the shop or field prime coat shall be properly repaired and touched up with the same material used for the original priming.
3. Where equipment is provided with nameplate data, the nameplate shall be masked off prior to painting. When painting is completed, remove masking material.

3.07 EXCAVATING

- A. Perform all excavating required for work of this Section. Provide the services of a pipe/cable locating service prior to excavating activities to determine location of existing utilities.
- B. Unless shown otherwise, provide a minimum of 2'-6" cover above top of pipe to finished grade for all service piping, unless otherwise noted. Trim trench bottom by hand or provide a 4 inch deep minimum bed of sand to provide a uniform grade and firm support throughout entire length of pipe. For all PVC pipe and for PE gas pipe, bed the pipe in 4 inch sand bed. Pipe bedding materials should be clean crushed rock, gravel or sand of which 100 percent will pass a 1 inch sieve. For pipes that are larger than 10 inches in diameter, at least 95 percent should pass a 3/4 inch sieve, and for pipes 10 inches in diameter or smaller, 100 percent should pass a 1/2 inch sieve. All other materials should have a minimum sand equivalent of 50. Only a small proportion of the native soils will meet these requirements without extensive processing; therefore, importation of pipe bedding materials should be anticipated. Pipe bedding materials shall be compacted in lifts not exceeding 6 inches in compacted thickness. Each lift shall be compacted to not less than 90 percent relative compaction at or above the optimum moisture content, in accordance with

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ASTM Specification D2940, except that bedding materials graded such that 100 percent of the material will pass a No. 200 sieve shall be compacted in 6 inch lifts using a single pass of a flat-plate, vibratory compactor or vibratory drum. Pipe bedding materials should extend at least to the spring line.

- C. Maintain all warning signs, barricades, flares, and red lanterns as required.
- D. For all trenches 5 feet or more in depth, submit copy of permit detailed drawings showing shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation of such trenches. Obtain a permit from the Division of Industrial Safety prior to beginning excavations. A copy of the permit shall be available at the site at all times.

3.08 BACKFILLING

- A. Backfill shall comply with applicable provisions of Division 31 of these Specifications.
- B. Except under existing or proposed paved areas, walks, roads, or similar surfaces, backfill for other types of pipe shall be made using suitable excavated material or other approved material. Place backfill in 8 inch layers, measured before compaction, and compact with impact hammer to at least 90 percent relative compaction per ASTM D2940.
 - 1. Backfill plastic pipe and insulated pipe with sand for a minimum distance of 12 inches above the top of the pipe. Compact using mechanical tamping equipment.
- C. Entire backfill for excavations under existing or proposed pavements, walks, roads, or similar surfaces, under new slabs on grade, shall be made with clean sand compacted with mechanical tamping equipment vibrator to at least 90 percent relative compaction per ASTM D2940. Remove excess earth. Increase the minimum compaction within the uppermost two feet of backfill to 95 percent.
- D. Replace or repair to its original condition all sod, concrete, asphalt paving, or other materials disturbed by the trenching operation. Repair within the guarantee period as required.

3.09 PIPING SYSTEMS INSTALLATION

- A. At time of final connection, and prior to opening valve to allow pressurization of water and gas piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on

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water piping is greater than 80 psi, or gas pressure is not as indicated on Contract Documents, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.

B. General:

1. All piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.
2. Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.
3. Install piping to permit application of insulation and to allow valve servicing.
4. Where piping or conduit is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.
5. Horizontal runs of pipes and/or electrical conduit suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.
6. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.
7. Each piping system shall be thoroughly flushed and proved clean before connection to equipment.
8. Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.
9. Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.
10. Install horizontal valves with valve stem above horizontal.
11. Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.
12. Verify final equipment locations for roughing-in.
13. Service Markers: Mark the location of each plugged or capped pipe with a 4 inch round by 30 inch long concrete marker, set flush with finish grade.

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Provide 2-1/2 inch diameter engraved brass plate as part of monument marker.

14. Furnish and install anchors or thrust blocks on PVC water lines in the ground, at all changes in direction of piping, and at all connections or branches from mains 1-1/2 inch and larger. Form anchors or thrust blocks by pouring concrete between pipe and trench wall. Thrust blocks shall be of adequate size and so placed as to take thrusts created by maximum internal water pressure. Sizing and placement shall be per manufacturer's recommendations, CPC, and IAPMO installation standards. Anchor piping to building construction.
15. Sanitary Sewer and Storm Drain: Grade piping inside building uniformly 1/4 inch per foot if possible but not less than 1/8 inch per foot. Run piping as straight as possible. Make piping connections between building piping and outside service pipe with cast iron reducers or increasers. Slope sewers uniformly between given elevations where invert elevations are shown.
16. Where piping is installed in walls within one inch of the face of stud, provide a 16 gauge sheet metal shield plate on the face of the stud. The shield plate shall extend a minimum of 1-1/2 inches beyond the outside diameter of the pipe.

C. Expansion Loops:

1. Install expansion loops where piping crosses building expansion or seismic joints, between buildings, between buildings and canopies, and as indicated on Drawings.
2. Install expansion loops of sizes matching sizes of connected piping.
3. Install grooved-joint expansion joints to grooved-end steel piping.
4. Materials of construction and end fitting type shall be consistent with pipe material and type of gas or liquid conveyed by the piping system in which expansion loop is installed.

D. Sleeves:

1. Install Adjus-to-Crete, Pipeline Seal and Insulator, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations as directed shall be caulked with oakum and mastic and made

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watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.

2. At Contractor's option, Link-Seal, Metraflex Metraseal, or equal, casing seals may be used in lieu of caulking. Wrap pipes through slabs on grade with 1 inch thick fiberglass insulation to completely isolate the pipe from the concrete.

E. Floor, Wall, and Ceiling Plates:

1. Fit all pipes with or without insulation passing through walls, floors, or ceilings, and all hanger rods penetrating finished ceilings with chrome-plated or stainless escutcheon plates.

F. Firestopping:

1. Pack the annular space between the pipe sleeves and the pipe through all floors and walls with UL listed fire stop, and sealed at the ends. All pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.
 - a. Install fire caulking behind mechanical services installed within fire rated walls, to maintain continuous rating of wall construction.
2. Provide SpecSeal Systems UL fire rated sleeve/coupling penetrators for each pipe penetration or fixture opening passing through floors, walls, partitions or floor/ceiling assemblies. All Penetrators shall comply with UL Fire Resistance Directory (Latest Edition), and in accordance with Chapter 7, CBC requirements.
3. Sleeve penetrators shall have a built in anchor ring for waterproofing and anchoring into concrete pours or use the special fit cored hole penetrator for cored holes.
4. Copper and steel piping shall have SpecSeal plugs on both sides of the penetrator to reduce noise and to provide waterproofing.
5. All above Systems to be installed in strict accordance with manufacturer's instructions.
6. Alternate firestopping systems are acceptable if approved equal. However, any deviation from the above specification requires the Contractor to be responsible for determining the suitability of the proposed products and their intended use, and the Contractor shall assume all risks and liabilities whatsoever in connection therewith.

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G. Flashing:

1. Flashing for penetrations of metal or membrane roof for mechanical items such as flues and pipes shall be coordinated with the roofing manufacturer and roofing installer for the specific roofing type. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.
 - a. Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.
 - b. Furnish and install counterflashing above each flashing required. Provide Stoneman, or equal, vandalproof top and flashing combination. Provide vandalproof top for each plumbing vent through roof. Elmdor/Stoneman Model 1540, 1550, 1570, or equal.
2. For all other types of roofing system, furnish and install around each pipe, where it passes through roof, a flashing and counterflashing. All flashing shall be made of four pound seamless sheet lead with 6 inch minimum skirt and steel reinforced boot. Counterflashing shall be cast iron. For vents, provide vandalproof top and flashing combination. Elmdor/Stoneman Model 1100-4, 1100-5, 1100-7, or equal.

H. Hangers and Supports:

1. General: Support equipment and piping so that it is firmly held in place by approved iron hangers and supports and special hangers. Hanger and support components shall support weight of equipment and pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments or hangers, of same size as pipe or tubing on which used, or nearest available. Rigidly fasten hose faucets, fixture stops, compressed air outlets, and similar items to the building construction. The Architect shall approve hanger material before installation. Do not support piping with plumbers' tape, wire rope, wood, or other makeshift devices. Where building structural members do not match piping support spacing, provide "bridging" support members firmly attached to building structural members in a fashion approved by the structural engineer.
 - a. Materials, design, and type numbers per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.

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- 1) Provide copper-plated or felt-lined hangers for use on copper tubing.
2. Hanger components shall be provided by one manufacturer: B-Line, Grinnell, Unistrut, Badger, or equal.
3. Riser clamps: B-line model B3373, or equal.
4. Pipe Hanger and Support Placement and Spacing:
 - a. Vertical piping support spacing: Provide riser clamps for piping, above each floor, in contact with the floor. Provide support at joints, branches, and horizontal offsets. Provide additional support for vertical piping, spaced at or within the following maximum limits:

Pipe Diameter	Steel Threaded or Welded (Note 3)	Steel Gas	Copper Brazed or Soldered (Note 3)	CPVC & PVC (Note 2)
1/2 - 1"	12 ft.	6 ft.	Each Floor, Not to Exceed 10 ft.	Base and Each Floor (Note 1)
1-1/4 - 2"	12 ft.	Each Floor, Not to Exceed 10 ft.	Each Floor, Not to Exceed 10 ft..	Base and Each Floor (Note 1)
2-1/2 - 3"	12 ft.	Each Floor, Not to Exceed 10 ft.	Each Floor, Not to Exceed 10 ft.	Base and Each Floor (Note 1)
Over 4"	12 ft.	Each Floor, Not to Exceed 10 ft.	Each Floor, Not to Exceed 10 ft.	Base and Each Floor (Note 1)

- 1) Note 1: Provide mid-story guides.
- 2) Note 2: For PVC piping, provide for expansion every 30 feet per IAPMO installation standard. For CPVC piping, provide for expansion per IAPMO installation standard.

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- 3) Note 3: Spacing of hangers and supports for piping assembled with mechanical joints shall be in accordance with standards acceptable to authorities having jurisdiction.
- b. Vertical cast iron piping support spacing: Base and each floor not to exceed 15 feet.
- c. Horizontal piping, hanger and support spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and spaced at or within following maximum limits:

Pipe Diameter	Steel Threaded or Welded (Note 2)	Steel Gas	Copper Brazed or Soldered (Notes 2, 3)	CPVC & PVC (Note 1)
1/2 - 1"	6 ft.	6 ft.	5 ft.	3 ft.
1-1/4 - 2"	7 ft.	10 ft.	6 ft.	4 ft.
2-1/2 - 3"	10 ft.	10 ft.	10 ft.	4 ft.
Over 4"	10 ft.	10 ft.	10 ft.	4 ft.

- 1) Note 1: For PVC piping, provide for expansion every 30 feet per IAPMO installation standard. For CPVC piping, provide for expansion per IAPMO installation standard.
- 2) Note 2: Spacing of hangers and supports for piping assembled with mechanical joints shall be in accordance with standards acceptable to authorities having jurisdiction.
- 3) Note 3: Includes all refrigerant piping, including vapor and hot gas pipes.
- d. Horizontal cast iron piping support spacing:
 - 1) Support piping at every other joint for piping length of less than 4 feet.
 - 2) For piping longer than 4 feet, provide support on each side of the coupling, within 18 inches of each joint.
 - 3) Hanger shall not be installed on the coupling.
 - 4) Provide support at each horizontal branch connection.
 - 5) Provide sway brace at 40 foot maximum spacing for suspended pipe with no-hub joints, except where a lesser spacing is required

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by the seismic design criteria used in delegated design for seismic systems. Refer to Article, Submittals.

- 6) Provide a brace on each side of a change in direction of 90 degrees or more.

5. Suspended Piping:

- a. Individually suspended piping: B-Line B3690 J-Hanger or B3100 Clevis, complete with threaded rod, or equal. All hangers on supply and return piping handling heating hot water or steam shall have a swing connector at point of support.

Pipe Size	Rod Size Diameter
2" and Smaller	3/8"
2-1/2" to 3-1/2"	1/2"
4" to 5"	5/8"
6"	3/4"

- b. Trapeze Suspension: B-Line 1-5/8 inch width channel in accordance with manufacturer's published load ratings. No deflection to exceed 1/180 of a span.
- c. Trapeze Supporting Rods: Shall have a safety factor of five; securely anchor to building structure.
- d. Pipe Clamps and Straps: B-Line B2000, B2400; isolate copper pipe with two thicknesses of 2 inches wide 10-mil polyvinyl tape. Where used for seismic support systems, provide B-Line B2400 series pipe straps.
- e. Concrete Inserts: B-line B22-I continuous insert or B2500 spot insert. Do not use actuated fasteners for support of overhead piping unless approved by Architect.
- f. Steel Connectors: Beam clamps with retainers.

6. Support to Structure:

- a. Wood Structure: Provide and install wood blocking as required to suit structure. Provide lag screws or through bolts with length to suit requirements, and with size (diameter) to match the size of hanger rods required.

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- 1) Do not install Lag screws in tension without written review and acceptance by Structural Engineer.

Side Beam Angle Clip	B-Line B3062---MSS Type 34
Side Beam Angle Clip	B-Line B3060
Ceiling Flange	B-Line B3199

- 2) Blocking for support of piping shall be not less than 2 inch thick for piping up to 2 inch size. Provide 3 inch blocking for piping up through 5 inch size, and 4 inch blocking for larger piping. Provide support for blocking in accordance with Structural Engineers requirements.
 - 3) Where lag screws are used, length of screw shall be 1/2 inch less than the wood blocking. Pre-drill starter holes for each lag screw.
- b. Steel Structure: Provide and install additional steel bracing as required to suit structure. Provide through bolts with length to suit requirements of the structural components. Burning or welding on any structural member may only be done if approved by the Architect.
7. Rubber Neoprene Pipe Isolators:
- a. Pipe isolators shall comprise an internal rubber or neoprene material that isolates pipe from hanger and structure. Install at all piping located in acoustical walls. Refer to Architectural Drawings for location of acoustical walls.
 - b. Isolation material shall be either a rubber or neoprene material that prevents contact between the pipe and the structure. The rubber shall have between a 45 to 55 durometer rating and a minimum thickness of 1/2 inch.
 - c. Acceptable Suppliers:
 - 1) Vertical runs: Acousto-Plumb or equal.
 - 2) Horizontal runs: B-Line, Vibraclamp; Acousto-Plumb or equal.
8. Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.
 9. Provide rigid insulation and a 12 inch long, 18 gauge galvanized sheet iron shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering.

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10. Insulate copper tubing from ferrous materials and hangers with two thicknesses of 3 inch wide, 10 mil polyvinyl tape wrapped around pipe.
11. Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.
12. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power actuated inserts will not be allowed.

3.10 UNION AND FLANGE INSTALLATION

- A. Install Watts, Epco, Nibco, or equal, dielectric unions or flanges at points of connection between copper or brass piping or material and steel or cast iron pipe or material except in drain, waste, vent, or rainwater piping. Bushings or couplings shall not be used. Dielectric unions installed in potable water systems shall conform to the lead-free requirements of the California Health and Safety Code Section 11 68 75.
- B. Install unions in piping NPS 2" and smaller, and flanges in piping NPS 2-1/2" and larger whether shown or not at each connection to all equipment and tanks, and at all connections to all automatic valves, such as temperature control valves. Unions installed in potable water systems shall conform to the lead-free requirements of the California Health and Safety Code Section 11 68 75.
- C. Locate the unions for easy removal of the equipment, tank, or valve.

3.11 ACCESS DOOR INSTALLATION

- A. Furnish and install access doors wherever required whether shown or not for easy maintenance of mechanical systems; for example, at concealed valves, strainers, traps, cleanouts, dampers, motors, controls, operating equipment, etc. Access doors shall provide for complete removal and replacement of equipment.

3.12 CONCRETE WORK

- A. Concrete work required for work of this Section shall be included under another section of the Specification, unless otherwise noted, including poured-in-place concrete work for installing precast manholes, catch basins, etc., and shall include reinforced concrete bases for pumps, tanks, compressors, fan units, boilers, unless the work is specifically indicated on the Drawings to be furnished under this Section.

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- B. Thrust blocks, underground anchors, and pads for cleanouts, valve access boxes and washer boxes are included under this Section of the Specification. Concrete shall be 3000 psi test minimum. Refer to Division 03 for concrete types.

3.13 PIPE PROTECTION

- A. Wrap bare galvanized and black steel pipe buried in the ground and to 6" above grade, including piping in conduit, with one of the following, or equal:
 - 1. Polyethylene Coating: Pressure sensitive polyethylene coating, "X-Tru-Coat" as manufactured by Pipe Line Service Corporation or "Green Line" wrap as manufactured by Royston Products, or equal.
 - a. Field Joints and Fittings: Protecto Wrap #1170 tape as manufactured by Pipe Line Service Corporation, or Primer #200 tape by Royston Products, or equal. Installation shall be as per manufacturer's recommendation and instructions.
 - 2. Tape Wrap: Pressure-sensitive polyvinyl chloride tape, "Transtex #V-10 or V-20", "Scotchwrap 50", Slipknot 100, PASCO Specialty & Mfg., Inc., or equal, with continuous identification. Tape shall be a minimum of 20 mils thick for fittings and irregular surfaces, two wraps, 50 percent overlap, 40 mils total thickness. Tape shall be laminated with a suitable adhesive; widths as recommended by the manufacturer for the pipe size. Wrap straight lengths of piping with an approved wrapping machine.
- B. Field Joints: Valves and Fittings: double wrap polyvinyl chloride tape as above. Provide at least two thicknesses of tape over the joint and extend a minimum of 4 inches over adjacent pipe covering. Build up with primer to match adjacent covering thickness. Width of tape of fittings shall not exceed 3 inches. Tape shall adhere tightly to all surfaces of the fittings without air pockets.
- C. Testing: Test completed wrap of piping, including all epoxy painted piping with Tinker and Razor Co. test machine (San Gabriel, CA - 818-287-5259), Pipeline Inspection Company (Houston, TX - 713-681-5837), or equal.
- D. Cleaning: Clean all piping thoroughly before wrapping.
 - 1. Inspection: Damaged or defective wraps shall be repaired as directed. No wrapped pipe shall be covered until approved by Architect.
- E. Sleeve copper piping/tubing installed below slab with "Polywrap-C" polyethylene sleeve, as manufactured by Northtown Pipe Protection Products, or equal. Sleeve shall be a minimum of 6 mils thick, colored blue for domestic

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water piping and orange for other piping. Install sleeve per manufacturer's recommendations and instructions.

- F. Sleeve copper piping/tubing installed outside building below grade with "Polywrap-C" polyethylene sleeve, as manufactured by Northtown Pipe Protection Products, or equal. Sleeve shall be a minimum of 6 mils thick, colored blue for domestic water piping. Install sleeve per manufacturer's recommendations and instructions.
- G. Sleeve cast iron and ductile iron pipe below grade and below slab with "Polywrap" polyethylene sleeve, as manufactured by Northtown Pipe Protection Products, or equal. Sleeve shall be a minimum of 8 mils thick, colored natural. Install sleeve per manufacturer's recommendations and instructions.
- H. Covering: No rocks or sharp edges shall be backfilled against the wrap or sleeve. When backfilling with other than sand, protect wrap with an outer wrapping of Kraft paper; leave in place during backfill.

3.14 PIPE IDENTIFICATION

- A. Provide temporary identification of each pipe installed, at the time of installation. Temporary identification shall be removed and replaced with permanent identification as part of the work.
- B. Apply the legend and flow arrow at all valve locations; at all points where the piping enters or leaves a wall, partition, cluster of piping or similar obstruction, at each change of direction and at approximately 20'-0" intervals on pipe runs. Variations or changes in locations and spacing may be made with the approval of the Architect. There shall be at least one marking in each room. Markings shall be located for maximum visibility from expected personnel approach.
 - 1. Apply legend and flow arrow at approximately 10'-0" intervals in science classrooms and science prep rooms.
- C. Wherever two or more pipes run parallel, the markings shall be supplied in the same relative location on each.
- D. Each valve on non-potable water piping shall be labeled with a metal tag stamped "DANGER -- NON-POTABLE WATER" in 1/4 inch high letters.
- E. Apply markings after painting and cleaning of piping and insulation is completed.

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3.15 EXPANSION ANCHORS IN HARDENED CONCRETE

- A. Refer to Structural Drawings.
- B. Qualification Tests: The specific anchor shall have a current ICC-ES report and evaluated in cracked concrete in accordance with Acceptance Criteria AC193. If the specific anchor satisfies cyclic testing requirements per Acceptance Criteria AC01, Section 5.6, the full allowable shear and tension loads listed in the current ICC-ES report and manufacturer's recommendations for the specific anchor may be used. Otherwise, the design shear and tension loads shall not be more than 80% of the listed allowable shear and tension loads for the specific anchor.
- C. Installation: The anchors must be installed in accordance with the requirements given in ICC Research Committee Recommendations for the specific anchor.
- D. Testing: Fifty percent of the anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of a special inspector.
- E. The load may be applied by any method that will effectively measure the tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor or calibrated spring-loading devices. Anchors in which the torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.

3.16 PIPING SYSTEM PRESSURE TESTING

- A. General:
 - 1. Perform operational tests under simulated or actual service conditions, including one test of complete plumbing installation with fixtures and other appliances connected.
 - 2. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- B. Piping Systems: Test piping systems in accordance with the following requirements and applicable codes:
 - 1. Authority having jurisdiction shall witness tests of piping systems.
 - 2. Notify Architect at least seven days in advance of testing.

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3. All piping shall be tested at completion of roughing-in, or at other times as directed by Architect.
 4. Furnish necessary materials, test pumps, gases, instruments and labor required for testing.
 5. Isolate from system equipment that may be damaged by test pressure.
 6. Make connections to existing systems with flanged connection. During testing of new work, provide a slip-in plate to restrict test pressure to new systems. Remove plate and make final connection to existing system at completion of testing.
 - a. Authority having jurisdiction shall witness final connection to system.]
- C. Test Schedule: No loss in pressure or visible leaks shall show after four hours at the pressures indicated.
- D. Testing of Sanitary Sewer, Drain, Vent, and Storm Drain may be done in segments in order to limit pressure to within manufacturer’s recommendations. Test to 10 feet above highest point in the system.

System Tested	Test Pressure PSI	Test With
Sanitary Sewer, Drain, Vent	10 Ft. Hd.	Water
Storm Drain, Condensate Drains	10 Ft. Hd.	Water
Domestic Water	125	Water
Natural Gas (PE)	60	Air & Non-corrosive Leak Test Fluid
Natural Gas (Steel)	100	Air & Non-corrosive Leak Test Fluid
Compressed Air	200 lb.	Air & Non-corrosive Leak Test Fluid
Deionized Water	50	Water

1. Flush deionized water lines with deionized water after test and approval.
2. Non-corrosive leak test fluid shall be suitable for use with piping material specified, and with the type of gas conveyed by the piping system.

3.17 TRACER WIRES

- A. Provide tracer wire for non-metallic gas and water pipe in ground outside of buildings. Use AWG #14 tracer wire with low density high molecular weight

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polyethylene insulation, and lay continuously on pipe so that it is not broken or stressed by backfilling operations. Secure wire to the piping with tape at 18 inch intervals. Solder all joints. Tracer wire insulation shall be colored yellow for gas piping, blue for water piping.

- B. Terminals: Precast concrete box and cast iron locking traffic cover, Brooks 3TL, or equal; cover marked with name of service; 6 inches of loose gravel below box. Plastic terminal board with brass bolts; identify line direction with plastic tags. Test for continuity between terminals, after backfilling, in presence of Inspector.

- C. Alternate: Use electronically detectable plastic tape with metallic core, Terra Tape D, manufactured by Reef Industries, Inc., Seton, Inc., Marking Services, Inc., or equal; tape 2 inches wide, continuously imprinted "CAUTION WATER (GAS, etc.) LINE BELOW". Install, with printed side up, directly over pipe, 18 inches below finish grade. Backfill material shall be as specified for the particular condition where pipe is installed, but avoid use of crushed rock or of earth with particles larger than 1/2 inch within the top 12 inches of backfill. Take precautions to insure that tape is not damaged or misplaced during backfill operations. Terminal boxes not required.

3.18 OPERATION OF SYSTEMS

- A. Do not operate any plumbing equipment for any purpose, temporary or permanent, until all of the following has been completed:
 - 1. Complete all requirements listed under "Check, Test and Start Requirements."
 - 2. Piping has been properly cleaned. Piping systems shall be flushed and treated prior to operation.
 - 3. Filters, strainers etc. are in place.
 - 4. Bearings have been lubricated, and alignment of rotating equipment has been checked.
 - 5. Equipment has been run under observation, and is operating in a satisfactory manner.

- B. Provide test and balance agency with one set of Contract Drawings, Specifications, Addenda, Change orders issued, applicable shop drawings and submittals and temperature control drawings.

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3.19 CHECK, TEST AND START REQUIREMENTS

- A. An authorized representative of the equipment manufacturer shall perform check, test and start of each piece of plumbing equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the check test and start of the equipment.
 - 1. As part of the submittal process, provide a copy of each manufacturer's printed startup form to be used.
 - 2. Some items of specified equipment may require that check, test and start of equipment must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
 - 3. Provide all personnel, test instruments, and equipment to properly perform the check, test and start work.
 - 4. When work has been completed, provide copies of reports for review, prior to final observation of work.
- B. Provide copies of the completed check, test and start report of each item of equipment, bound with the Operation and Maintenance Manual.
- C. Upon completion of the work, provide a schedule of planned maintenance for each piece of equipment. Indicate frequency of service, recommended spare parts (including filters and lubricants), and methods for adjustment and alignment of all equipment components. Provide a copy of the schedule with each operating and maintenance manual. Provide a copy of certification from the Owner's representative indicating that they have been properly instructed in maintenance requirements for the equipment installed.

3.20 PRELIMINARY OPERATIONAL REQUIREMENTS AND TESTS

- A. Prior to observation to determine final acceptance, put all mechanical systems into service and check that work required for that purpose has been done, including but not limited to the following condensed check list. Provide indexed report to tabulating the results of all work.
 - 1. All equipment has been started, checked, lubricated and adjusted in accordance with the manufacturer's recommendations.
 - 2. Correct rotation of motors and ratings of overload heaters are verified.

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3. Specified filters are installed and spare filters have been turned over to Owner.
 4. All manufacturers' certificates of start-up specified have been delivered to the Owner.
 5. All equipment has been cleaned, and damaged painted finishes touched up.
 6. Missing or damaged parts have been replaced.
 7. Flushing and chemical treatment of piping systems has been completed and water treatment equipment, where specified, is in operation.
 8. Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.
 9. Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop instructions have been posted.
 10. Preliminary test and balance work is complete, and reports have been forwarded for review.
 11. Automatic control set points are as designated and performance of controls checks out to agree with the sequence of operation.
 12. Operation and Maintenance Manuals have been delivered and instructions to the operating personnel have been made.
- B. Prior to the observation to determine final acceptance, operate all mechanical systems as required to demonstrate that the installation and performance of these systems conform to the requirements of these specifications.
1. Operate and test all mechanical equipment and systems for a period of at least five consecutive 8 hour days to demonstrate the satisfactory overall operation of the project as a complete unit.
 2. Commence tests after preliminary balancing and adjustments to equipment have been checked. Immediately before starting tests, install air filters and lubricate all running equipment. Notify the Architect at least seven calendar days in advance of starting the above tests.
 3. During the test period, make final adjustments and balancing of equipment, systems controls, and circuits so that all are placed in first class operating condition.

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4. Where Utility District rebates are applicable, demonstrate that the systems meet the rebate program requirements.

C. Review of Contractor's Tests:

1. All tests made by the Contractor or manufacturers' representatives are subject to observation and review by the Owner. Provide timely notice prior to start of each test, in order to allow for observation of testing. Upon the completion of all tests, provide a letter to confirm that all testing has been successful.

D. Test Logs:

1. Maintain test logs listing the tests on all mechanical systems showing dates, items tested, inspectors' names, remarks on success or failure of the tests.

E. Preliminary Operation:

1. The Owner reserves the right to operate portions of the plumbing system on a preliminary basis without voiding the guarantee.

3.21 CERTIFICATES OF INSTALLATION

- A. Contractor shall complete applicable "Certificates of Installation" forms contained in the California Building Energy Efficiency Standards and submit to the authorities having jurisdiction for approval and issuance of final occupancy permit, as described in the California Energy Code.

3.22 DEMONSTRATION AND TRAINING

- A. An authorized representative of the equipment manufacturer shall train Owner-designated personnel in maintenance and adjustment of equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the Owner training for the equipment installed.
 1. As part of the submittal process, provide a training agenda outlining major topics and time allowed for each topic.
 2. Some items of specified equipment require that training must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.

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3. Contractor shall provide three copies of certification by Contractor that training has been completed, signed by Owner's representative, for inclusion in Operation and Maintenance Manual. Certificates shall include:
 - a. Listing of Owner-designated personnel completing training, by name and title.
 - b. Name and title of training instructor.
 - c. Date(s) of training.
 - d. List of topics covered in training sessions.
4. Refer to specific equipment Articles for minimum training period duration for each piece of equipment.

END OF SECTION

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SECTION 22 05 53 - PLUMBING IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.02 RELATED REQUIREMENTS

- A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
- B. Section 09 90 00 - Paints and Coatings: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.04 SUBMITTALS

- A. See Section 00 72 00 - Submittals, for submittal procedures.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Seton Identification Products: www.seton.com/aec.

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2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: Equipment, control panels 1 inch.
 - 3. Letter Height: Thermostats and small control components, 1/4 inch.
 - 4. Background Color: Black.

2.03 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. Access Doors and Similar Operational Instructions: Minimum 3/4" high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

2.05 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- D. Service Markers: Identify buried plugged or capped pipe with concrete marker, 4 inch diameter by 30 inches long, set flush with grade. Provide engraved brass nameplate identifying pipe stub.

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PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 90 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify domestic hot water heating equipment, including water heaters, pumps, expansion tanks, etc. with plastic nameplates.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Tag automatic controls, instruments, and relays. Key to control schematic.
- J. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- K. Provide red ceiling dots to locate valves above T-bar type panel ceilings. Locate in corner of T-bar panel closest to equipment.

END OF SECTION

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SECTION 22 10 00 - PLUMBING PIPING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Valves.
 - 3. Domestic water piping specialties.
 - 4. Drain and waste piping specialties.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 22 00 50 Plumbing Materials and Methods.

1.03 ACTION SUBMITTALS

- A. For additional requirements, refer to Section 22 00 50, Plumbing Materials and Methods.
- B. Product Data: Submit manufacturer's technical product data and installation instructions for plumbing piping systems materials and products.

1.04 INFORMATIONAL SUBMITTALS

- A. For additional requirements, refer to Section 22 00 50, Plumbing Materials and Methods.
- B. Provide welding certificate for all gas pipe welders.
- C. Gas Pipe Installer Qualifications: Provide evidence of current qualifications for individuals performing work requiring qualifications.

1.05 CLOSEOUT SUBMITTALS

- A. For additional requirements, refer to Section 22 00 50, Plumbing Materials and Methods.

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- B. Maintenance Data: Submit maintenance data and parts lists for plumbing piping systems materials and products. Include this data in Operation and Maintenance Manual.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish to Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

1.07 QUALITY ASSURANCE

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Gas Pipe Installer Qualifications: Individuals performing tasks requiring qualifications under Federal and State regulations shall be qualified by the gas utility supplying Project site. The qualifications shall be current at the time of performing the Work.
- C. NFPA/ANSI Compliance: Fabricate and install natural gas systems in accordance with latest edition of NFPA 54/ANSI Z223.1 "National Fuel Gas Code."
- D. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- E. Fabricate and install natural gas systems in accordance with California Plumbing Code.
- F. Utility Compliance: Fabricate and install natural gas systems in accordance with local gas utility company requirements.

1.08 REFERENCE STANDARDS

- A. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges; 2021.
- B. ASME B31.1 - Power Piping; 2022.
- C. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- D. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- E. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2020.
- F. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.

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- G. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- H. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.
- I. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.
- J. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.
- K. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.
- L. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing; 2016.
- M. ASTM F1412 - Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems; 2016.
- N. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- O. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.
- P. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- Q. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
- R. FM 1680 - Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential; 1989.
- S. MSS SP-67 - Butterfly Valves; 2022.
- T. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- U. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- V. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- W. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

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X. NFPA 54 - National Fuel Gas Code; 2024.

PART 2 PRODUCTS

2.01 MATERIALS AND PRODUCTS

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Provide materials and products complying with California Plumbing Code. Where more than one type of material or product is indicated, selection from materials or products specified is Contractor's option.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Plastic piping components shall be marked with "NSF-pw."

2.02 PIPE AND FITTINGS ATTACHED TO AND BELOW BUILDINGS INCLUDING 5 FEET FROM BUILDINGS

- A. Piping and fittings attached to covered walkways and corridors shall comply with the requirements of this article.
- B. Drain and Waste Pipe Above Grade: Cast iron soil pipe and fittings, asphaltic coated, conforming to ASTM A888 and Cast Iron Soil Pipe Institute Standard (CISPI) 301 and so marked. Pipe and fittings shall be as manufactured by AB&I, Charlotte, Tyler Pipe, or equal. Pipe and fittings shall be the products of a single manufacturer. At Contractor's option, vertical piping above floor from lavatories, sinks, and drinking fountains may be Schedule 40 galvanized steel pipe with black cast iron drainage fittings, or DWV weld pipe and fittings.
 - 1. Joints above grade: No-Hub pipe conforming to ASTM A888 and CISPI 301. Couplings conforming to ASTM 1277 and CISPI 310, with stainless steel bands. Provide products by ANACO-Husky, Tyler, Ideal or equal. Provide sway brace at 20'-0" maximum spacing for suspended pipe with No-Hub joints. Provide a brace on each side of a change in direction of 90 degrees or more. Brace riser joints at each floor and at 15 foot maximum intervals (also see Specification Section 22 00 50).
- C. Drain and Waste Pipe Below Grade: Cast iron soil pipe and fittings, asphaltic coated, conforming to ASTM A888 and CISPI 301 and so marked. Pipe and fittings shall be as manufactured by AB&I, Charlotte, Tyler Pipe, or equal. Pipe and fittings shall be the products of a single manufacturer. At Contractor's option, hub and spigot cast iron soil pipe and fittings, asphaltic coated, conforming to ASTM A-74 and so marked, may be used.

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1. Joints below grade: ANACO-Husky SD 4000, Clamp-All 125, or equal couplings and No-Hub fittings, meeting the requirements of FM 1680, SD Class I and ASTM C1540.
 2. Joints below grade (hub and spigot option): Neoprene gaskets conforming to ASTM C564, as manufactured by Ty-Seal, Dual-Tite, or equal.
- D. Vent Pipe:
1. 3 inch and larger: Cast iron soil pipe and fittings conforming to ASTM A888 and Cast Iron Soil Pipe Institute Standard 301 and so marked. Joints in cast iron vent pipe shall be the same as specified for cast iron waste pipe above grade.
 2. 2-1/2 inch and smaller: Cast iron soil pipe and fittings as specified for sizes 3 inch and larger, Schedule 40 galvanized steel pipe with black cast iron drainage fittings, or DWV copper pipe and fittings.
 3. Vent pipe buried in ground and to 6 inches above ground: Cast iron soil pipe and fittings conforming to ASTM A888 and Cast Iron Soil Pipe Institute Standard 301 and so marked. Joints in cast iron vent pipe shall be the same as specified for cast iron waste pipe below ground.
- E. Type DWV copper tubing or No-Hub cast iron pipe and fittings may be used for concealed rainwater leaders. Where no-hub piping is used, the fittings and couplings shall match those used for waste piping.
- F. Grease Waste (GW) and Vent (GV) Pipe Underground to 6 Inches Aboveground: George Fisher Sloane, Inc., "Fuseal PP," Orion Fittings, Inc., "Rionfuse CF," IPEX, Inc., "Enfield," or equal, Schedule 40 polypropylene pipe and fittings assembled with electrofusion joints. Piping shall comply with ASTM F1412.
- G. Grease Waste (GW) and Vent (GV) Pipe Aboveground:
1. In inaccessible spaces or within walls, George Fisher Sloane, Inc., "Fuseal PP," Orion Fittings, Inc., "Rionfuse CF," IPEX, Inc., "Enfield," or equal, flame-retardant schedule 40 polypropylene pipe and fittings assembled with electrofusion joints. Piping shall comply with ASTM F1412.
 2. In accessible areas: George Fisher Sloan, Inc. "Fuseal PP," Orion Fittings, Inc. "Blueline," IPEX, Inc. "Labline," or equal, flame retardant Schedule 40 polypropylene drainage pipe and fittings, with mechanical joints. Piping shall comply with ASTM F1412.

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3. Vent pipe aboveground: 3 Inches and Larger: Service weight cast iron soil pipe and fittings; 2-1/2 inches and smaller: Schedule 40 galvanized steel pipe with black cast iron drainage fittings.

- H. Water Pipe (Tempered Water, Tempered Water Return, Hot Water, Hot Water Return and Cold Water): ASTM B88, Type L copper tubing, hard-temper, with wrought copper fittings. Provide full solder cup for all fittings. Capped or plugged outlets shall be Schedule 40 screwed brass. Water piping below slab: ASTM B88, Type K copper tubing, hard temper, with wrought copper fittings. At Contractor's option, pipe runs below slab having no branches may be ASTM B88, Type K annealed copper tubing without joints. See Section 22 00 50 for pipe protection requirements for below slab copper piping.

- I. Temperature and Pressure Relief Valve Piping: ASTM B88, Type L copper tubing, hard-temper, with wrought copper fittings. Provide full solder cup for all fittings. Capped or plugged outlets shall be Schedule 40 screwed brass.

- J. Gas Pipe: Schedule 40 black steel conforming to ASTM A53, with malleable iron threaded fittings above grade for piping 2 inch and smaller; welded piping below grade and for above grade piping larger than 2 inches, with Class 150 welding fittings.
 1. Appliance Flexible Connectors for Indoor Equipment Without External Spring Isolation:
 - a. Contractor may choose one of the following:
 - 1) Direct gas pipe connection.
 - 2) Appliance flexible connector:
 - (a) Comply with ANSI Z21.24.
 - (b) Polymer or hot-dipped PVC coated corrugated 304 stainless steel.
 - (c) Operating-Pressure Rating: 0.5 psig.
 - (d) End Fittings: Zinc-coated steel.
 - (e) Maximum Length: 30 inches.
 - (f) Manufacturers: Dormont, Series 30C, 31, 40C, 41, and 51, Brasscraft model ProCoat, or equal.
 - b. Provide with end connections compatible with equipment and piping system.

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- c. Equipment located in spaces normally accessible to building occupants, other than maintenance personnel, shall utilize direct gas pipe connection.
- d. Provide anti-microbial PVC coating for use with appliances located in kitchen areas.

K. Condensate Drain Piping:

- 1. Inside buildings provide ASTM B88, Type L copper tubing and fittings. Provide Wye fittings with capped cleanout plug for tubing up to 1 inch size. Provide wrought or cast DWV fittings for sizes 1-1/4 inch and larger.
- 2. Outside buildings provide ASTM B88, Type L copper pipe and fittings, cast iron drain pipe and fittings or Schedule 40 galvanized steel pipe and cast iron drain or vent fittings.]
- 3. Connect condensate drains to mechanical equipment per equipment manufacturer's recommendations; provide P-trap where required. Slope piping to drain, with 1 inch in 10 foot minimum pitch. Provide di-electric couplings or unions at connections to dissimilar materials.
- 4. Where Drawings indicate installation of mechanical equipment on spring isolation rails spring mounted curbs, or spring hangers, provide threaded metal connector at mechanical equipment, Metraflex Model SST, or equal by Unisource Mfg. Co., or Flexicraft Industries. Arrange flexible connection to ensure drainage of condensate, and support flexible connection at each end of connector, to ensure proper alignment.
- 5. Where condensate drain P-traps are required, install trap using Wye fitting on inlet and outlet of trap. Provide cap on top of each Wye, made removable for cleaning and inspection. Drill 1/8 inch diameter hole in cap at outlet of the trap to allow venting of the system. Minimum depth of trap should be 4 inches, or as recommended by the manufacturer in printed literature.
- 6. Provide cleanout tees or "Y" at each change in direction.

2.03 PIPE JOINING MATERIALS

- A. Refer to piping Articles in this Section for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

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1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated
 - a. Full-Face Type: For flat-face, Class 125, cast iron and cast bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast iron and steel flanges.
2. AWWA C111, rubber, flat face, 1/8-inch (3.2mm) thick, unless otherwise indicated; and full-face or ring type, unless other indicated.
3. Flange Bolts and Nuts: AWWA C111, carbon steel, unless otherwise indicated.
4. Plastic, Pipe-Flange Gasket, Bolts and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, 100 percent lead free alloys. Include water-flushable flux according to ASTM B813.
- D. Brazing Filler Metals: AWS A5.8, BCup-5 Series, copper-phosphorus unless otherwise indicated. Sil-Fos 15, or equal.
- E. Welding Filler Metals: Comply with ASME B31.1 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Solvent Cements for Joining CPVC Piping: ASTM F 493.
 1. CPVC solvent cement shall have VOC content of 490 g/L or less.
 2. Adhesive primer shall have VOC content of 550 g/L or less.
 3. Solvent cement and adhesive primer shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
- G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 1. PVC solvent cement shall have VOC content of 510 g/L or less.
 2. Adhesive primer shall have VOC content of 550 g/L or less.
 3. Solvent cement and adhesive primer shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

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2.04 VALVES AND FITTINGS FOR POTABLE WATER SYSTEMS

A. General:

1. Provide valves and fittings conforming to lead-free requirements of California Health and Safety Code Section 11 68 75.
 - a. Provide valves listed to NSF/ANSI 61-G or NSF/ANSI 372 for valve materials for potable-water service.
 - 1) Exception: Main distribution gate valves above 1-1/2 inches located underground outside building are not required to conform lead-free requirements of California Health and Safety Code Section 11 68 75.

B. Gate Valves:

1. General: Furnish valves in copper lines with adapters to suit valve/line requirements.
2. 1-1/2 inches and smaller: Minimum 200 psi CWP, bronze body, threaded bonnet, rising or non-rising stem, solid wedge, threaded or solder ends, conforming to MSS SP-80. Milwaukee UP148, UP149, Nibco T-113-LF, S-113-LF, or equal.
3. 2 inches through 3 inches: Minimum 200 psi CWP, bronze body, threaded bonnet, non-rising stem, solid wedge, threaded or solder ends, conforming to MSS SP-80. Nibco T-113-LF, S-113-LF, or equal.
4. Main distribution gate valves underground outside building above 1-1/2 inches:
 - a. Underground valves 2 inches thru 12 inches: 250 psi, iron body, Non-rising stem, bolted bonnet, resilient wedge valves, conforming to AWWA C509, equipped with operating nuts, Mueller Series 2360, Nibco F-619-RW-SON, or equal.
 - 1) Underground valves 3 inches and smaller may be furnished with operating nuts or hand-wheels, and with Ring-Tite joint ends.
 - 2) Furnish and deliver to Owner one wrench of each size required for operating underground valves.

C. Ball Valves:

1. 2 inches and smaller: 600 psi CWP, cast bronze or brass body, full port, two piece, threaded ends, and reinforced PTFE seal, conforming to MSS

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SP-110. Nibco T-685-80-LF, Milwaukee UPBA400, Apollo 77C-LF10, Kitz 868, or equal.

2. 2-1/2 inches: Apollo 77C-LF10, or equal.

2.05 VALVES AND FITTINGS FOR NON-POTABLE WATER, COMPRESSED AIR,
AND GAS SYSTEMS

A. Gas Shut-off Valve Above Grade:

1. 2 inches and smaller: Provide Milwaukee BB2-100, Jomar T-100NE, or equal, ball valve, CSA listed, full port.
2. Above 2 inches: Provide ReSun D-126, Key Port, or equal, CSA listed, rectangular port, full pipe area, 125 psi SWP, flanged ends. Provide T-Handle socket wrench and adapter fittings as required for operation of valves. Provide one package of spare lubricant sticks, sizes as required for valve sizes. Lubricant shall be the product recommended by valve manufacturer for use with type of gas conveyed by the piping system.
3. Provide valves same size as upstream piping. Make any reduction in size of gas piping downstream of shutoff valves.

2.06 DOMESTIC WATER PIPING SPECIALTIES

A. Hose Bibbs:

1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
 - a. Acorn Engineering Co.
 - b. Woodford Manufacturing Co.
2. Hose Station: Leonard THS-25-VB-CW, Symmons, or equal.

B. Water Hammer Arrestors:

1. Provide water hammer arrestors conforming to lead-free requirements of California Health and Safety Code Section 11 68 75, with nesting type bellows contained within a casing having sufficient displacement volume to dissipate the calculated kinetic energy generated in the piping system. Water hammer arrestors shall be sized for type and number of fixtures served. Provide all stainless steel shell construction with stainless steel bellows and threaded connection to water system.

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2. Water hammer arrestors shall be certified under P.D.I. Standard WH201 and by ASSE Standard 1010.
 3. Select units in accordance with the requirements of Plumbing and Drainage Institute Standard P.D.I. WH201. Install above ceilings or behind wall access door at each plumbing fixture, or where plumbing fixtures are installed in groups, at each group of fixtures.
 4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Josam Company, series 75000.
 - b. Smith (Jay R.) Mfg. Co., Hydrotrol 5005-5050.
 - c. Mifab, series WHB.
- C. Double Check Valve Backflow Preventers:
1. Refer to Section 21 10 00 for backflow preventers for fire protection service.
 2. Provide double detector check valve assembly consisting of two spring loaded brass check valves, two cast iron bronze fitted gate valves and four test cocks, equal to Febco Model 856 or 876 as required. Construct in accordance with ASSE Standard 1048.
 3. Provide LeMeur, Hot-Box, or equal, two piece backflow preventer enclosure, sized to suit the size of backflow preventer. Install on concrete pad, in accordance with manufacturer's written installation instructions.]
 4. Provide substantial padlock and chain to lock valves in open position and turn key over to Project Inspector.
 - a. Padlocks shall be as specified under Section 08 70 00.
 - b. Chain shall be of carbon steel, 3/8 inch wire diameter, fully welded links and weight of 140 pounds per 100 lineal feet. Chain shall be hot galvanized.
 5. Provide capped connections at each test cock. Install in accordance with requirements of Authority Having Jurisdiction.
 6. Provide two concrete filled, 6 inch diameter pipe bollards to protect all exposed piping from motor vehicle damage.

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7. Provide Christy, or equal, utility box sized as required to suit backflow assembly, complete with two piece reinforced concrete lid, concrete extensions, insulation and other construction details shown on the drawings.
 8. Manufacturers: Subject to compliance with requirements and local water authorities having jurisdiction, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ames.
 - b. Febco Sales, Inc.
 - c. Watts Regulator Company.
 - d. Clow.
- D. Thermostatic Water Temperature Control Valve:
1. Provide thermostatic water temperature control valve conforming to lead free requirements of California Health and Safety Code Section 11 68 75, with size as noted on Drawings, complete with union angle strainer checkstops. Valves shall be thermostatic type, with a maximum temperature setting as follows:
 2. Provide surface recessed semi-recessed mounted, white enameled or stainless steel cabinet with locking door for control valves. Including:
 - a. Control valve cabinet and valve shall be provided as a package, and include thermostatic water mixing valve, thermometer, safety checkstops, volume control valve and internal piping.
 3. Where indicated on drawings, provide a temperature alarm system, utilizing a micro-processor based controller and solid state temperature controller. Provide audible and visual indication of high and low temperature set points. Provide required hardware and wiring for a complete operating system.
 - a. Provide isolation transformer for control of the alarm system.
 - b. Provide solenoid valve and shock absorber, installed and wired to the alarm module.
 4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

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- a. Leonard Valve Company.
- b. Lawler Manufacturing Co., Inc.
- c. Powers.

E. Trap Primers:

- 1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
 - a. MiFab, Inc.
 - b. Precision Plumbing Products.
 - c. Sioux Chief Manufacturing Company.

2.07 DRAIN AND WASTE PIPING SPECIALTIES

A. Cleanouts:

- 1. General: Install cleanouts of same diameter as pipe (4 inch maximum) in all horizontal soil and waste lines where indicated and at all points of change in direction. Cleanouts shall be located not less than 18 inches from building construction so as to provide sufficient space for rodding. No horizontal run over 50 feet inside buildings or 100 feet outside buildings shall be without cleanout, whether shown on Drawings or not. Provide two-way cleanouts where indicated on drawings, and whenever sanitary sewer exits building. All two-way cleanouts shall have (2) risers, each in opposing directions.
 - a. Provide cleanouts in waste drop from each sink and urinal.
 - b. Provide one wrench for each size and type of cleanout used. Turn over to Owner at completion of the project, and obtain receipt. Place receipt in Operation and Maintenance Manuals.
- 2. Cleanouts in floor and in concrete sidewalks: Ducco Cast Iron with nickel bronze top, clamping collar and ABS plastic plug: Zurn ZN-1400-KC, or equal, with square or round top to suit floor construction.
- 3. Cleanouts in composition floors: Zurn ZN-1400-X-DX, or equal (nickel bronze top).
- 4. Cleanouts in concealed, aboveground cast-iron soil or waste lines: Zurn Z-1440A, or equal, with ABS plastic plug.

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5. Cleanouts in walls: Zurn Z-1441 or Z-1443, or equal, with stainless steel cover. Provide long sweep elbow or combination wye at connection to riser and install with surface of cleanout within ½ inch of front face of finished wall.
 - a. Where space does not permit the above installation, provide Zurn Z-1446, or equal, with stainless steel access cover, and vandal resistant screw.
 - b. Install face of cleanout plug within 1/2 inch of front face of finished wall.
 6. Cleanouts exterior to building in landscaped areas: Zurn Z-1449-BP, or equal, cleanout ferrule with tapered bronze plug. Where located at grade, provide 18 by 18 by 6 inch concrete pad; Trowel concrete smooth and edge; set flush with finished grade.
 7. Cleanouts in drive areas: Zurn -1400-HD-KC, or equal, with heavy-duty top and ABS plastic plug.
 8. Cleanouts in acid waste systems: Zurn ZN-1404, or equal, cleanout access housing, with ductile cast iron body and nickel bronze top. Extend acid waste piping within the cleanout, and terminate with threaded cap. Secure acid waste pipe inside cleanout access housing with setscrews provided.
- B. Floor Drains:
1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
 - a. J.R. Smith.
 - b. MIFAB.
 - c. Watts.
 - d. Zurn.
- C. Floor Sinks:
1. Floor Sinks: Provide anchoring flange (seepage pan) at all floor sinks, and provide flashing clamp in locations where floor membrane is used. Provide cast iron "P" trap and trap primer connection at P-Trap.

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2. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
 - a. J.R. Smith.
 - b. MIFAB.
 - c. Watts.
 - d. Zurn.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which plumbing piping systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Contractor.
- B. Make all arrangements for the utilities required. Pay all costs involved in obtaining the services including gas service and meter, water meter, pressure reducing valve, access boxes, street work. Connect to site utilities. Verify the location of all services. No extra cost will be allowed if services are not as shown.
- C. Determine sanitary sewer and storm drain location and elevation at all points of connection before installing any piping. Notify Architect immediately if indicated grades cannot be maintained.
- D. At time of final connection, and prior to opening valve to allow pressurization of water and gas piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on water piping is greater than 80 psi, or gas pressure is not as indicated on Contract Documents, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.

3.02 INSTALLATION OF WATER PIPING

- A. Run all water piping generally level, free of traps or unnecessary bends, arranged to conform to the building requirements, and to suit clearance for other mechanical work such as ducts, flues, conduits, and other work. No piping shall be installed so as to cause unusual noise from the flow of water therein under normal conditions.
- B. Provide manufactured water hammer arrestors, sized and installed in accordance with Plumbing and Drainage Institute Standard PDI WH201.

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1. Locate water hammer arrestors at every plumbing fixture, or, where fixtures are located in groups, at every group of fixtures, and as indicated on Drawings.
 2. Install water hammer arresters above accessible ceilings, or install access doors for service.
- C. In freezing locations arrange water piping to drain as shown.]
- D. Install piping on room side of building insulation.
- E. Check final location of rubber rings within couplings on PVC water piping with gauge or as recommended by manufacturer. Make connection to valves with cast iron adapters connected to water pipe with cast iron couplings. Furnish and install anchors or thrust blocks.]
- F. For all faucets, hose bibbs, or other water outlets delivering industrial hot and/or cold water, provide a sign, permanently mounted, indicating "CAUTION: NON-POTABLE WATER, DO NOT DRINK". Each sign shall be permanently engraved with black uppercase letters on a yellow background. Letters shall be minimum 1-1/4 inch high.]

3.03 INSTALLATION OF SANITARY AND STORM DRAINAGE SYSTEMS

- A. Make joints in PVC sewer pipe with PVC-type couplings and rubber rings.
- B. Check final location of rubber rings within the couplings with gauge or as recommended by the manufacturer. Make joints between PVC pipe and cast iron pipe or fittings using cast iron adapter fittings, installed as recommended by the manufacturer.
1. Ring-Tite cast iron pipe fittings may be used in lieu of standard fittings. Make connection to valves with cast iron adapters connected to the pipe with PVC couplings.
- C. Sewer Piping: Run all horizontal sanitary drain piping inside of building on a uniform grade of not less than 1/4 inch per foot unless otherwise noted or later approved. Unless otherwise noted on the plans, piping shall have invert elevations as shown and slope uniformly between given elevations.
- D. Storm Drain Piping: Run all horizontal storm drain piping inside of building on a uniform grade of not less than 1/4 inch per foot. Unless otherwise noted on the plans, piping shall have invert elevations as shown and slope uniformly between given elevations.

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- E. Install rainwater leader nozzles at exposed bottom of leaders where they spill onto grade.
- F. Run all drainage piping as straight as possible and provide easy bends with long turns; make all offsets at an angle of 45 degrees or less.
- G. Grade all vent piping so as to free itself quickly of any water condensation.
- H. Where possible, join groups of vent risers together with one enlarged outlet through roof. Maintain minimum of 10 foot horizontal or 3 foot vertical clearance from air intakes.
- I. Install drip pan under storm drain piping, sanitary drain piping, and vent piping that must be run over kitchen areas.
- J. Hubless Cast Iron Joints: Comply with coupling manufacturer's installation instructions.

3.04 INSTALLATION OF GREASE WASTE PIPING SYSTEMS

- A. Install to comply with all manufacturers' recommendations.
- B. All buried pipe shall be bedded in and backfilled with 4 inches of sand, and installed as recommended by manufacturer.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Maintain continuous pressure test on piping installed below grade, until all work has progressed to above grade.
- D. Electrofusion joints: Make polypropylene drainage piping joints according to ASTM F 1290.

3.05 PIPE JOINTS AND CONNECTIONS

- A. General:
 - 1. Cutting: Cut pipe and tubing square, remove rough edges or burrs. Bevel plain ends of steel pipe.
 - 2. Remove scale, slag, dirt and debris from inside and outside of pipe before assembly.
 - 3. Boss or saddle type fittings or mechanically extracted tube joints will not be allowed.
- B. Threaded Pipe: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded

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pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply thread compound to external pipe threads: Rectorseal No. 5, Permatex No. 1, or equal.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- C. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- D. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 3. PVC Piping: Join according to ASTM D 2855.
- E. Copper Pipe and Tubing (Except pneumatic control piping): All joints shall be brazed according to ASME Section IX, Welding and Brazing Qualifications, except domestic water piping 1-1/4 inches and smaller when not buried in the ground or concrete and type DWV plumbing piping may be soldered.
1. Soldered joints: Apply water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828.
- F. Cast Iron Soil Pipe:
1. No-Hub fittings shall be made with a torque wrench.
 2. Hub joints shall be with Ty-Seal couplings.
 3. Wrought iron, steel, or copper pipe shall have a ring or part of a coupling screwed on to form a spigot end if caulked into a joint.
 4. Connect cast iron sewer piping to outside service pipe with cast iron or vitrified LOP reducers or increasers as required. Caulking of smaller pipe into the larger without a reducer or increaser will not be permitted.
- G. Welded Pipe:
1. Make up with oxyacetylene or electric arc process.

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2. All line welds shall be of the single "V" butt type. Welds for flanges shall be of the fillet type.
 3. Where the branch is two pipe sizes smaller than the main or smaller, Bonney Weldolets, Thredolets, Nibco, or equal, may be used in lieu of welding tees.
- H. PVC Sewer and Drainage Pipe (outside building as allowed only): Four inches and larger shall be bell and spigot, assembled in accordance with manufacturer's recommendations. Joint shall be tested in accordance with ASTM D3212. Solvent weld joints below 4 inches in size, schedule 40 PVC with matching fittings, assembled per manufacturer's instructions.
- I. Polyethylene and Polypropylene Pipe: Assemble with fusion joints in strict accordance with manufacturer's instructions.
- J. Make joints in PVC water pipe with PVC couplings and rubber rings, Manville Ring-Tite, PW Pipe, or equal. Check final location of rubber rings with the couplings with gauge or as recommended by the manufacturer. Make joints between PVC pipe and cast iron pipe or fittings using cast iron or PVC adapter fittings, installed as recommended by the manufacturer. Ring-Tite PVC or cast iron pipe fittings may be used in lieu of standard fittings. Make connection to valves with cast iron adapters connected to the water pipe with PVC couplings.
- K. Flexible Connections:
1. Furnish and install Thermo Tech., Inc. F/J/R, Metraflex, or equal, flexible couplings with limiter bolts on piping connections to all equipment mounted on anti-vibration bases, on each connection to each base mounted pump and where shown. Couplings shall be suitable for pressure and type of service.
 2. Anchor piping securely on the system side of each flexible connection.

3.06 INSTALLATION OF VALVES

- A. Install valves as indicated on Drawings and in the following locations:
1. Shutoff Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.
 2. Drain Valves: Install on each plumbing equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere indicated or required to completely drain potable water system.

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3. Provide gate or globe valves on inlet and outlet of each water heater or pump.

B. General:

1. Valves shall be full line size unless indicated otherwise on Drawings.
2. Install horizontal valves with valve stem above horizontal, except butterfly valves.
3. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
4. Locate valves for easy access and provide separate support where necessary.
5. Install valves in position to allow full stem movement.
6. Install exposed polished or enameled connections with special care showing no tool marks or exposed threads.
7. Butterfly valves conforming to the paragraph "Butterfly Valves" may be used in lieu of gate or globe valves for locations above grade.
8. Ball valves conforming to the paragraph "Ball Valves" may be used in lieu of gate valves for locations above grade for services 2-1/2 inches and smaller.
9. Valves 2-1/2 inches and smaller (except ball valves) in nonferrous water piping systems may be solder joint type with bronze body and trim.
10. Rigidly fasten hose bibbs, hydrants, fixture stops, compressed air outlets, and similar items to the building construction.

C. Gate Valves:

1. Furnish valves in copper lines with adapters to suit valve / line requirements.
2. Underground gate valves:
 - a. Underground valves 3 inches and smaller may be furnished with operating nuts or hand-wheels, and with Ring-Tite joint ends.
 - b. Furnish and deliver to Owner one wrench of each size required for operating underground valves.

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- D. Swing Check Valves: Install in horizontal position with hinge pin level.
- E. Butterfly Valves: Install with stems horizontal.
- F. Silent Check Valves: Install in horizontal or vertical position between flanges.
- G. Calibrated Balancing Valves: Install calibrated balancing valves per manufacturers' recommendations, including requirements for straight pipe lengths at valve inlet and outlet.
- H. Gas Shut-Off Valves:
 - 1. Provide line size ball valve in gas line to each appliance.
 - 2. Provide line size ball valve in gas line, to be used as emergency shut-off for science classrooms. Install valve in locking box where indicated on the drawings.
 - 3. Provide line size electric solenoid gas valve in gas line to kitchen equipment (if not supplied with appliance) under Type 1 hood. Interlock with hood fire alarm system.
- I. Valve Adjustment: Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.07 INSTALLATION OF CLEANOUTS

- A. Cleanouts: Install in piping as indicated, as required by California Plumbing Code, at each change in direction of piping greater than 45 degrees. Install at maximum intervals of 50 feet for piping 4 inches and smaller and 100 feet for larger piping inside buildings, and at base of each conductor.
- B. Flashing Flanges: Install flashing flange and clamping device with each cleanout passing through water resistant membrane.

3.08 INSTALLATION OF FLOOR DRAINS AND FLOOR SINKS

- A. Install drains in accordance with manufacturer's written instructions and in locations indicated. Install floor drains with lip of drain slightly below finished floor to ensure drainage. Install floor sinks flush with finished floor. Coordinate with other trades to ensure that floor slopes to drain. Provide flashing flange and clamping device with each drain passing through water resistant membrane.
- B. Install vented P-trap below each drain. Where trap primers are indicated, install trap primer connection in the P-trap.

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3.09 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers where indicated on Drawings. Provide drain connection available from the manufacturer at drain connection, pipe drain outlet to the nearest floor drain.
 - 1. Where drain pans are shown on the Drawings, pipe drain pan outlet to nearest floor drain.

3.10 TRAP PRIMER INSTALLATION

- A. Install as indicated in manufacturers printed literature, with 1/2 inch, Type L, hard copper piping to trap primer connection on floor drains and floor sinks where indicated on Drawings. At Contractor's option, Type K annealed copper tubing without joints may be used below slab only. See Section 22 00 50 for pipe protection requirements for below slab copper piping/tubing.
- B. Install trap primer piping with 1/4 inch per foot slope, to insure that the line will drain fully to the floor drain or floor sink.
 - 1. Provide ball valve to the inlet at each trap primer location.
- C. Install trap primer and distribution unit exactly as called for in manufacturers printed installation instructions. Connect to domestic water piping from the top of the water line, in order to prevent foreign material from entering directly into primer assembly.
- D. Mount trap primer in wall, in sheet metal box, with Karp or equal access door. Size access door and box to suit valve operation, and solder all seams of box. Seal all penetrations to box with non-hardening waterproof sealant. Provide locking door where installed in occupied spaces.
- E. Where one trap primer will be used for more than one trap, provide a distribution unit with feeder piping for a maximum of four traps sized for equal pressure drop to each trap.

3.11 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system and gas piping system to mechanical equipment as indicated, and provide with shutoff valve and union for each connection.

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3.12 KITCHEN EQUIPMENT INSTALLATION

- A. Coordinate all work with Specification Section for kitchen equipment.
- B. All equipment shall be fully connected.
- C. Furnish and install all required "P" traps.
- D. Provide stops on all hot and cold water lines at equipment, in an accessible position. Include lines to kettle and range swing faucets.
- E. Water pressure for dishwasher and glass-washer to be 25 pound maximum. Provide pressure reducing valves on water line to washers.
- F. All floor openings are to be sealed watertight.
- G. Indirect waste lines required for standard or fabricated items of kitchen equipment, except sinks, shall be furnished and installed by the kitchen equipment contractor.
- H. Provide all sink drains. All indirect drains shall terminate above floor sinks at least 1-1/2 times ID of drain line and shall be so set that flare will not spill on floor area.
- I. Provide approved vacuum breaker or anti siphon device on water lines to equipment wherever required.
- J. Provide gas pressure regulators for modular front manifold cooking equipment assemblies. Pressure regulators shall be adjustable from 2 inch to 7 inch water column and shall be set for approximately 6 inches W.C. at manifold connection.
- K. All gas pressure regulators shipped loose with gas fired equipment shall be installed by plumbing contractor.
- L. The kitchen equipment contractor will provide all equipment trim including faucets and sink wastes and swing faucets at kettles all to be installed by Plumbing contractor.
- M. All horizontal piping lines connected to equipment shall be run at the highest possible elevation not less than 6 inches above floor. Piping rough-in shall be stubbed in walls wherever possible.
- N. Vent piping for waste lines shall be concealed wherever possible and vertical vents for island or free-standing equipment shall be avoided. Any required exposed vents shall be submitted to the Architect for approval.

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- O. Kitchen equipment contractor to furnish coffee maker. Plumbing contractor shall provide a cold water connection terminating in a 3'-0" length of 1/4 inch OD soft copper tubing with a 1/4 inch female flare fitting on the end.
- P. Fire protection systems for ventilators and cooking equipment are furnished and installed by kitchen equipment contractor unless shown otherwise on the drawings. Gas valves which are a part of the fire protection systems are furnished only. Plumbing Contractor shall install gas valves.
- Q. Connect movable gas-fired cooking equipment utilizing flexible gas connection system.

3.13 DOMESTIC WATER SYSTEM STERILIZATION

- A. Clean and disinfect new or altered hot and cold water piping connected to domestic water systems using methods prescribed by the Health Authority. If the Health Authority does not prescribe methods, clean and disinfect new or altered hot and cold water piping using methods given in the California Plumbing Code.
 - 1. A water treatment company that has a current state EPA license to apply disinfectant chlorine in potable water shall perform the procedure.

3.14 CARE AND CLEANING

- A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures, and trim that are installed as part of this work. Remove labels from stainless steel sinks, except 316 stainless steel sink labels should be retained to confirm that the correct material has been provided. Leave systems and equipment in satisfactory operating condition.

3.15 OPERATIONAL TESTS

- A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.16 TESTING AND BALANCING

- A. See Section 23 05 93 of Specifications for testing and balancing requirements.

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3.17 CLEANING UP

- A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

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SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Water supplies and stops.
 - 2. Plumbing fixture hangers and supports.
 - 3. Washing machine hose/supply boxes.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 22 00 50 Basic Plumbing Materials and Methods.

1.03 ACTION SUBMITTALS

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Product Data: Submit manufacturer's specifications for plumbing fixtures and trim, including catalog cut of each fixture type and trim item furnished.

1.04 INFORMATIONAL SUBMITTALS

- A. Refer to Section 22 00 50, Basic Plumbing Materials and Methods.

1.05 CLOSEOUT SUBMITTALS

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.
- B. Maintenance Data: Submit maintenance data and parts lists for each fixture type and trim item, including instructions for care of finishes. Include this data in Operation and Maintenance Manual.

1.06 QUALITY ASSURANCE

- A. For additional requirements, refer to Section 22 00 50, Basic Plumbing Materials and Methods.

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- B. Plumbing Fixture Standards: Comply with applicable portions of the following codes and requirements for all work in this Section:
 - 1. 2022 California Building Code – CBC
 - 2. 2022 California Plumbing Code – CPC
 - 3. 2022 California Health and Safety Code
 - 4. American National Standards Institute - ANSI
 - 5. Federal Standards - F.S.
 - 6. National Sanitary Foundation – NSF International
- C. ANSI Standards: Comply with ANSI/NSF 61, “Drinking Water System Components – Health Effects.”
- D. PDI Compliance: Comply with standards established by Plumbing and Drainage Institute pertaining to plumbing fixture supports.
- E. UL Labels: Provide water coolers that have been listed and labeled by Underwriters' Laboratories.
- F. ARI Labels: Provide water coolers that are rated and certified in accordance with applicable Air-Conditioning and Refrigeration Institute Standards.
- G. Americans with Disabilities Act (ADA).
- H. California Green Building Standards Code Requirements:
 - 1. Tank-type water closets shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Tank-Type Toilets.
 - 2. Single Showerheads shall be certified to the performance criteria of the U.S. EPA WaterSense Specification for Showerheads.

1.07 REFERENCE STANDARDS

- A. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- B. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.

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PART 2 PRODUCTS

2.01 PLUMBING FIXTURES

- A. General: Provide factory fabricated fixtures of type, style and material indicated. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by the manufacturer, and as required for a complete, installation. Where more than one type is dedicated, selection is Contractor's option; but, all fixtures of same type must be furnished by single manufacturer.
1. Take special care with the roughing-in and finished plumbing where batteries of fixtures occur.
 2. Take location and mounting heights for roughing-in from Architectural Drawings.
 3. Follow schedule on Plumbing Drawings for roughing-in connections. Set roughing-in for all fixtures exactly as per measurements furnished by the manufacturers of the fixtures used.
 4. Roughing-in for lavatories and sinks shall be brought in through the wall under the centerline of the drain from the fixture wherever possible and as close to the fixture as possible.

2.02 MATERIALS

- A. Provide materials that have been selected for their surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, foundry sand holes, stains, discoloration, or other surface imperfections on finished units are not acceptable.
- B. Where fittings, trim and accessories are exposed or semi-exposed, provide, chromium plated 17 gauge seamless brass and match faucets and fittings. Provide 17 gauge seamless copper or brass where not exposed.
- C. Handles on all faucets and stops shall be all metal chromium plated.
- D. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

2.03 PLUMBING FITTINGS, TRIM AND ACCESSORIES

- A. Water Outlets: At locations where water is supplied (by manual, automatic or remote control), provide commercial quality faucets, valves, or dispensing devices, of type and size indicated, and as required to operate as indicated.

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1. Include manual shutoff valves and connecting stem pipes to permit outlet servicing without shut-down of water supply piping systems.

- B. P-Traps: Include IAPMO approved removable P-traps where drains are indicated for direct connection to drainage system. P-Traps shall be less trap screw cleanout, and incorporate a chrome plated cast brass body, brass connection nuts, 17 gauge seamless brass wall return and chrome plated wall escutcheon to match trap finish.

- C. Carriers: Provide cast iron supports for fixtures of graphitic gray iron, ductile iron, or malleable iron as indicated. Where the carrier for wall mounted water closets are installed more than 6 inches behind the finished wall, provide water closet support for wide pipe chase.

- D. Fixture Bolt Caps: Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.

- E. Escutcheons: Where fixture supplies and drains penetrate walls in exposed location, provide chrome-plated cast brass escutcheons with setscrews.

- F. Aerators: Provide aerators of types approved by Health Departments having jurisdiction. Delete aerators where not allowed by CPC for health care occupancies.

- G. Comply with additional fixture requirements contained in Fixture Schedule shown on the drawings.

2.04 MANUFACTURERS

- A. In accordance with California Plumbing Code, provide indelibly marked or embossed manufacturers name or logo, arranged so as to be visible after installation.

- B. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following:
 1. Vitrified China Plumbing Fixtures:
 - a. American Standard, U.S. Plumbing Products.
 - b. Eljer Plumbingware Div., Wallace-Murray Corp.
 - c. Kohler Co.
 - d. Vitra.

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2. Modular Lavatories:
 - a. Bradley.
 - b. Acorn.
 - c. Willoughby Industries, Inc.

3. Plumbing Trim:
 - a. McGuire Manufacturing Co., Inc.
 - b. Delta Commercial.
 - c. Chicago Faucet Co.
 - d. T&S Brass and Bronze Works, Inc.

4. Flush Valves:
 - a. Sloan Valve Co.
 - b. Zurn Industries, Hydromechanics Div.
 - c. Toto USA, Inc.

5. Faucets:
 - a. Chicago Faucet Co.
 - b. Symmons Scott.
 - c. T&S Brass and Bronze Works, Inc.
 - d. Delta Commercial.

6. Fixture Seats:
 - a. Church Seat Co.
 - b. Bemis Mfg. Co.
 - c. Beneke Corp.

7. Water Coolers and Drinking Fountains:
 - a. Murdock
 - b. Haws Corporation.

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8. Service Sinks:
 - a. American Standard.
 - b. Kohler Co.
 - c. Williams Serviceceptor.
 - d. Florestone.
 - e. Acorn.

9. Stainless Steel Sinks:
 - a. Elkay Mfg. Co.
 - b. Just Mfg. Co.
 - c. Haws Corporation.

10. Showers:
 - a. Acorn.
 - b. Bradley.
 - c. Symmons.
 - d. Powers.

11. Emergency Equipment:
 - a. Haws Corporation.
 - b. Gardian.
 - c. Symmons.
 - d. Bradley.
 - e. Encon.

12. Fixture Carriers:
 - a. Josam Mfg. Co.
 - b. J. R. Smith.
 - c. Tyler Pipe; Wade Div.

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- d. Zurn Industries; Hydromechanics Div.
- e. Mifab, Inc.

2.05 FLUSH VALVE REQUIREMENTS

- A. Metering flush valves where required and specified shall be non-hold open type with exposed parts chrome plated. Conform to all codes and manufacturers' recommendations. All diaphragms are to have multiple filtered bypass and be chloramine resistant synthetic rubber with internal components suitable for 180 degree hot water to 150 pounds pressure, plastic or leather diaphragm not acceptable.
- B. Electronic flush valves where required and specified shall be non-hold open type with exposed parts chrome plated. Conform to all codes and manufacturers' recommendations. All diaphragms are to have multiple filtered by pass and be chloramine and resistant synthetic rubber with rubber and internal components suitable for 180 degree hot water to 150 pounds pressure, plastic or leather diaphragm not acceptable. All flush valve solenoids and sensors shall be UL listed.

2.06 FIXTURE CONNECTIONS

- A. Make connection between fixtures and flanges on soil pipe absolutely gastight and watertight with neoprene type gaskets (wall hung fixtures) or bowl wax (floor outlet fixtures). Rubber gaskets or putty will not be permitted.
- B. Provide fixtures not having integral traps with P-traps of chromium-plated 17 gauge cast brass, with 17 gauge seamless brass wall return, connected to concealed waste in wall and sanitary fittings. Provide IAPMO approval for trap, and provide less trap screw cleanout.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Dearborn Brass, Commercial series with brass nuts.
 - b. Delta Commercial.
 - c. McGuire Manufacturing Co., Inc.
- C. Connections from stacks or horizontal wastes to wall or floor finish for wastes from lavatories, urinals, sinks, and drinking fountains and connection between floor drains and traps shall be IPS 85 percent red brass pipe.

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- D. Plumbing fixture traps connected to special waste systems shall be constructed of materials to suit the waste system.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Orion.
 - b. Enfield
- E. Unions on waste pipes on fixture side of traps may be slip or flange joints with soft rubber or lead gaskets. Traps shall rough in full size to waste and vent connection, using deep escutcheon plate to cover wall penetration. Compression adaptor extensions or sweat adaptors are not acceptable.

2.07 WATER SUPPLIES AND STOPS

- A. Provide 85 percent IPS threaded red brass nipple, conforming to the lead-free requirements of California Health and Safety Code Section 11 68 75, securely anchored to building construction, for each connection to stops, hose bibbs, etc. Each fixture, except hose bibbs, shall have stop valves installed on water supply lines.
- B. Provide water supplies to fixtures with compression shut-off stops with threaded inlets and lock shield-loose key handles. Provide combination fixtures with compression stop and threaded inlet on each water supply fitting. Provide lock shield-loose key handle for each stop.
- C. Provide 1/2 inch riser tubes with reducing coupling for fixtures, unless otherwise noted.
- D. Provide cast brass escutcheon.
- E. Furnish shut-off valves on hose bibbs where directly connected to mains with no intervening valves.
- F. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. McGuire Manufacturing Company, Inc., model LFH2167LK.
 2. T & S Brass and Bronze Works, Inc., model B-1305.

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2.08 PLUMBING FIXTURE HANGERS AND SUPPORTS

- A. Floor-affixed supports for off-the-floor plumbing fixtures shall comply with ASME A112.6.1M.
- B. Residential type fixture supports are not acceptable.
- C. Install wall mounted water closets with combination support and waste fittings, with feet of support securely anchored to floor.
- D. Install floor mounted water closets with J.R. Smith, Zurn, or equal government pattern cast iron closet flanges with brass bolts, nuts, washers, and porcelain caps secured with Spackle.
- E. Install the following fixtures on concealed support with feet of support securely anchored to floor. Anchor top of support to wall construction in an approved manner.
 - 1. Wall hung lavatories.
 - 2. Wall mounted urinals.
 - 3. Drinking fountains.
 - 4. Electric water coolers.

2.09 PLUMBING FIXTURES

- A. Install all plumbing fixtures at height indicated on Architectural Drawings. Where mounting height is not indicated, install at height required by Code.
- B. Special Requirements For Accessible Fixtures:
 - 1. Operating handle or valve for accessible water closets, urinals, lavatories, and sinks shall operate with less than 5 pounds force. Metering faucets shall be adjusted to operate between 10 and 15 seconds.
 - 2. Insulate exposed waste piping and domestic water supplies below accessible fixtures with CBC access code compliant molded “closed-cell” vinyl covers. Covers shall be installed using vandal resistant fasteners and must be removable. Covers shall meet flame spread rating not to exceed 25 and smoke density not to exceed 50 when tested in accordance with ASTM E-84, and shall comply with the requirements of California Code of Regulations, Title 24. Plumberex – Handy Shield, Johns Manville – Zeston 2000, or equal.
- C. Washing Machine Hose/Supply Boxes:

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1. Manufacturers: Drawing schedules indicate Basis of Design products. Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following, or equal:
 - a. Acorn Engineering Co.

PART 3 EXECUTION

3.01 PRODUCT HANDLING AND PROTECTION

- A. Deliver packaged materials in their original, unopened wrapping with labels intact. Protect materials from water, the elements and other damage during delivery, storage and handling.

3.02 PREPARATORY PROVISIONS

- A. The Contractor is responsible for the examination and acceptance of all conditions affecting the proper construction and/or installation of the Work of this Section. Do not proceed until all unsatisfactory conditions have been corrected. Commencing work will be construed as acceptance of all conditions by the Contractor as satisfactory for the construction and/or installation of the Work.

3.03 INSPECTION AND PREPARATION

- A. Examine roughing-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of the National Standard Plumbing Code pertaining to installation of plumbing fixtures.
- C. Fasten plumbing fixtures securely to supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies to blocking behind or within wall construction so as to be rigid, and not subject to pull or push movement.
- D. Install CBC accessible fixtures in accordance with Chapter 4 California Plumbing Code, and Chapters 11A and 11B California Building Code.

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- E. Refer to Division 26 for wiring for electronic flush valves.]

3.04 FAUCET INSTALLATION

- A. Provide 85 percent IPS red brass pipe, conforming to lead-free requirements of California Health and Safety Code Section 11 68 75, securely anchored to building construction, for each connection to faucets, stops, hose bibbs, etc. Each fixture, except hose bibbs, shall have a stop valve installed on water supply lines to permit repairs without shutting off water mains.
- B. Adjust metering faucets to run for 10 to 15 seconds.

3.05 CLEAN AND PROTECT

- A. Clean plumbing fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during the remainder of the construction period.
- C. Grout voids between all fixtures and adjacent surfaces with white Dow Silicone Sealant, arranged to shed water.

3.06 FIELD QUALITY CONTROL

- A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

3.07 EXTRA STOCK

- A. General: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt. Furnish one device for every ten units.

END OF SECTION

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SECTION 23 00 50 - BASIC HVAC MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Electric motors.
 - 2. Motor starters.
 - 3. Strainers.
 - 4. Gauges.
 - 5. Thermometers.
 - 6. Access Doors.
 - 7. Flexible joints.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This Section is a part of each Division 23 Section.
- C. Refer to Section 23 08 00. T-24 Commissioning of HVAC for Title 24 commissioning and acceptance testing requirements.

1.03 ADDITIONAL REQUIREMENTS

- A. Furnish and install incidental work not shown or specified necessary to provide a complete and workable system.
- B. Make all temporary connections required to maintain services, including adequate heat and cooling, during the course of the Contract without additional cost to Owner. Notify Owner seven days in advance before disrupting services.
- C. Provide for adjustments or modifications to fan and motor sheaves, belts, damper linkages, and other components as required to achieve specified air balance at no additional cost to Owner.

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1.04 REFERENCES AND STANDARDS

A. Where material or equipment is specified to conform to referenced standards, it shall be assumed that the most recent edition of the standard in effect at the time of bid shall be used.

1. AABC - Associated Air Balance Council
2. AFBMA - Anti Friction Bearing Manufacturer's Association
3. AMCA - Air Moving and Control Association Inc.
 - a. Standard 210 - Laboratory Methods of Testing Fans
4. ANSI - American National Standards Institute
5. ARI - Air-Conditioning and Refrigeration Institute
6. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
7. ASME - American Society of Mechanical Engineers
8. ASTM - American Society for Testing and Materials
9. CCR - California Code of Regulations
 - a. Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36
10. CSA – Canadian Standards Association International
11. CSFM - California State Fire Marshal
12. NCPWB - National Certified Pipe Welding Bureau
13. NIST - National Institute of Standards and Technology
14. NEMA - National Electrical Manufacturers' Association
15. NFPA - National Fire Protection Association
16. OSHA - Occupational Safety and Health Act
17. SMACNA - Duct Manuals
18. UL - Underwriters' Laboratories, Inc.

B. Requirements of Regulatory Agencies:

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1. The publications listed below form part of this specification; comply with provisions of these publications except as otherwise shown or specified.
 - a. California Building Code, 2022.
 - b. California Electrical Code, 2022.
 - c. California Energy Code, 2022.
 - d. California Fire Code, 2022.
 - e. California Green Building Standards Code, 2022.
 - f. California Mechanical Code, 2022.
 - g. California Plumbing Code, 2022.
 - h. California Code of Regulations, Title 24.
 - i. California Health and Safety Code.
 - j. CAL-OSHA.
 - k. California State Fire Marshal, Title 19 CCR.
 - l. National Fire Protection Association.
 - m. Occupational Safety and Health Administration.
 - n. Other applicable state laws.
2. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes, or to requirements of authorities having jurisdiction. It is not the intent of Drawings or specifications to repeat requirements of codes except where necessary for clarity.

1.05 DRAWINGS

- A. Examine Drawings prior to bidding of work and report discrepancies in writing to Architect.
- B. Drawings showing location of equipment and materials are diagrammatic and job conditions will not always permit installation in location shown. The HVAC Drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as existing conditions, actual building construction, and work of other trades permit.

1. Architectural and Structural Drawings shall be considered part of the Work. These Drawings furnish Contractor with information relating to

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design and construction of the Project. Architectural Drawings take precedence over HVAC Drawings.

2. Because of the small scale of HVAC Drawings, not all offsets, fittings, and accessories required are shown. Investigate structural and finish conditions affecting the Work and arrange Work accordingly. Provide offsets, fittings, and accessories required to meet conditions. Inform Architect immediately when job conditions do not permit installation of equipment and materials in the locations shown. Obtain the Architects approval prior to relocation of equipment and materials.
 3. Relocate equipment and materials installed without prior approval of the Architect. Remove and relocate equipment and materials at Contactors' expense upon Architects' direction.
 4. Minor changes in locations of equipment, piping, ducts, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.
- C. Execute work mentioned in the Specifications and not shown on the Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.06 FEES AND PERMITS

- A. Obtain and pay for permits and service required in installation of the Work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Comply with requirements of Division 01.
- B. Arrange for utility connections and pay charges incurred, including excess service charges.
- C. Coordination:
 1. General:
 - a. Coordinate HVAC Work with trades covered in other Specifications Sections to provide a complete, operable and sanitary installation of the highest quality workmanship.
 2. Have fire damper and fire smoke damper installation instructions available at Project site during construction for use by Project Inspector.
 3. Electrical Coordination:

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- a. Refer to the Electrical Drawings and Specifications, Division 26, for service voltage and power feed wiring for equipment specified under this section. Contractor has full responsibility for the following items of work:
 - 1) Review the Electrical Drawings and Division 26 Specifications to verify that electrical services provided are adequate and compatible with equipment requirements.
 - 2) If additional electrical services are required above that indicated on Electrical Drawings and in Division 26, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include cost to furnish and install additional electrical services as part of the bid.
 - 3) Prior to proceeding with installation of additional electrical work, submit detailed drawings indicating exact scope of additional electrical work.

4. Mechanical Coordination:
 - a. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
 - b. Coordinate installation of supporting devices. Set sleeves in poured-in-place concrete and other structural components during construction.
 - c. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
 - d. Coordinate with other trades equipment locations, pipe, duct and conduit runs, electrical outlets and fixtures, air inlets and outlets, and structural and architectural features. Provide information on location of piping and seismic bracing to other trades as required for a completely coordinated project.

1.07 SUBMITTALS - GENERAL

- A. Refer to Division 01 Submittals Section(s) for additional requirements.

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- B. Submittal packages may be submitted via email as PDF electronic files, or as printed packages. PDFs shall be legible at actual size (100 percent). Provide seven copies of printed submittal packages.
- C. Provide submittal of materials proposed for use as part of this Project. Product names in Specifications and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the Contract regardless of disposition of submittal data. Other materials or methods shall not be used unless approved in writing by Architect. Architect's review will be required even though "or equal" or synonymous terms are used.
1. Partial or incomplete submittals will not be considered.
 2. Quantities are Contractor's responsibility and will not be reviewed.
 3. Provide materials of the same brand or manufacturer for each class of equipment or material.
 4. Identify each item by manufacturer, brand, trade name, number, size, rating, or other data necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.
 5. Identify each submittal item by reference to items' Specification Section number and paragraph, by Drawing and detail number, and by unit tag number.
 6. Organize submittals in same sequence as in Specification Sections.
 7. Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, and weight.
 - a. Submit Shop Drawings, performance curves, and other pertinent data, showing size and capacity of proposed materials.
 - b. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of Contract Documents.
 - c. Drawings shall be drawn to scale and dimensioned (except schematic diagrams). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and signed by Contractor before submission to Architect for review.
 - d. Catalog cuts and published material may be included with supplemental scaled drawings.

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- D. Review of submittals will be only for general conformance with design concept and general compliance with information given in Contract Documents. Review will not include quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with work of other trades, or construction safety precautions, which are sole responsibility of Contractor. Review of a component of an assembly does not indicate acceptance of an assembly. Deviations from Contract Documents not clearly identified by Contractor are Contractor's responsibility and will not be reviewed by Architect.
- E. Within reasonable time after award of contract and in ample time to avoid delay of construction, submit to Architect shop drawings or submittals on all items of equipment and materials provided. Provide submittal as a complete package.
 - 1. Shop drawings and submittals shall include Specification Section, Paragraph number, and Drawing unit symbol or detail number for reference. Organize submittals into booklets for each Specification section and submit in loose-leaf binders with index. Deviations from the Contract Documents shall be prominently displayed in the front of the submittal package and referenced to the applicable Contract requirement.
- F. Furnish to the Project Inspector complete installation instructions on material and equipment before starting installation.

1.08 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for plumbing systems materials and products.
- B. Shop Drawings.
- C. Sustainable Design Submittals:
 - 1. Product Data: For adhesives and sealants, documentation of compliance including printed statement of VOC content and chemical components.]
 - 2. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.]
- D. Delegated-Design Submittals: For seismic supports, anchorages, restraints, and vibration isolators indicated to comply with performance requirements and design criteria.
 - 1. Calculations performed for use in selection of seismic supports, anchorages, restraints, and vibration isolators shall utilize criteria indicated in Structural Contract Documents.

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2. Include design calculations and details for selecting vibration isolators and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the California registered structural engineer responsible for their preparation.
3. Supports, anchorage and restraints for piping, ductwork, and equipment shall be an HCAI pre-approved system such as TOLCO, ISAT, Mason, or equal. Pipes, ducts and equipment shall be seismically restrained in accordance with requirements of current edition of California Building Code. System shall have current OPM number and shall meet additional requirements of authority having jurisdiction. Provide supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping, ductwork and restraint locations.
 - a. Bracing of Piping, Ductwork, and Equipment: Specifically state how bracing attachment to structure is accomplished. Provide shop drawings indicating seismic restraints, including details of anchorage to building. In-line equipment must be braced independently of piping and ductwork, and in conformance with applicable building codes. Provide calculations to show that pre-approval numbers have been correctly applied in accordance with general information notes of pre-approval documentation.
 - b. In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, ductwork, and restraint locations, and detail supports, attachments and restraints, and furnish supporting calculations and legible details sealed by a California registered structural engineer, in accordance with 2016 California Building Code
4. Additional Requirements: In addition to the above, conform to all state and local requirements.

1.09 INFORMATIONAL SUBMITTALS

- A. Provide coordinated layouts for HVAC Ductwork systems, in accordance with Specification Section 23 80 00.
- B. Provide evidence of equipment certification to California Energy Code Section 110.1 or 110.2, if not providing Electrically Commutated motors for HVAC fans sized below 1 hp and above 1/12 hp. Refer to specific equipment articles requiring electrically commutated motors.
- C. Check, Test, and Start forms, from equipment manufacturers.

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D. Check, Test and Start reports.

1.10 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Furnish three complete sets of Operation and Maintenance Manual bound in hardboard binder, and one compact disc containing complete Operation and Maintenance Manual in searchable PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in binder and disc. Begin compiling data upon approval of submittals.

a. Sets shall incorporate the following:

- 1) Product Data.
- 2) Shop Drawings.
- 3) Record Drawings.
- 4) Service telephone number, address and contact person for each category of equipment or system.
- 5) Complete operating instructions for each item of heating, ventilating and air conditioning equipment.
- 6) Copies of guarantees/warranties for each item of equipment or systems.
- 7) Test data and system balancing reports.
- 8) Typewritten maintenance instructions for each item of equipment listing lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.
- 9) Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment.
- 10) Temperature control diagrams and literature.
- 11) Check test and start reports for each piece of mechanical equipment provided as part of the Work.
- 12) Commissioning and Preliminary Operation Tests required as part of the Work.

2. Post service telephone numbers and addresses in an appropriate place designated by Architect.

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- B. Record Drawings:
1. Refer to Division 01 for additional requirements.
 2. Upon completion of the Work, deliver to Architect the following:
 - a. Originals of drawings showing the Work exactly as installed.
 - b. One complete set of reproducible drawings showing the Work exactly as installed.
 - c. One compact disc with complete set of drawings in PDF format showing the Work exactly as installed.
 - d. Provide Contractor's signature, verifying accuracy of record drawings.
 - e. Obtain the signature of the Inspector of Record for Record Drawings.

1.11 SUBSTITUTIONS

- A. Refer to Division 01 for complete instructions. Requirements given below are in addition to or are intended to amplify Division 01 requirements. In case of conflict between requirements given herein and those of Division 01, Division 01 requirements shall apply.
- B. It is the responsibility of Contractor to assume costs incurred because of additional work and or changes required to incorporate proposed substitute into the Project. Refer to Division 01 for complete instructions.
- C. Substitutions will be interpreted to be manufacturers other than those specifically listed in the Contract Documents by brand name, model, or catalog number.
- D. Only one request for substitution will be considered for each item of equipment or material.
- E. Substitution requests shall include the following:
 1. Reason for substitution request.
 2. Complete submittal information as described herein; see "Submittals."
 3. Coordinated scale layout drawings depicting position of substituted equipment in relation to other work, with required clearances for operation, maintenance and replacement.
 4. List optional features required for substituted equipment to meet functional requirements of the system as indicated in Contract Documents.

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5. Explanation of impact on connected utilities.
 6. Explanation of impact on structural supports.
- F. Installation of reviewed substitution is Contractors' responsibility. Any mechanical, electrical, structural, or other changes required for installation of substituted equipment or material must be made by Contractor without additional cost to Owner. Review by Architect of substituted equipment or material, will not waive these requirements.
- G. Contractor may be required to compensate Architect for costs related to substituted equipment or material.

1.12 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of HVAC systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with HVAC systems work similar to that required for this Project.
- C. Comply with applicable portions of California Mechanical Code pertaining to selection and installation of HVAC materials and products.
- D. All materials and products shall be new.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment and materials delivered to Project site from weather, humidity and temperature variations, dirt, dust and other contaminants.

1.14 FIELD CONDITIONS

- A. Contractor shall visit Project site and examine existing conditions in order to become familiar with Project scope. Verify dimensions shown on Drawings at Project site. Bring discrepancies to the attention of Architect. Failure to examine Project site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that affect Project scope.]
- B. Information on Drawings relative to existing conditions is approximate. Deviations from Drawings necessary during progress of construction to conform to actual conditions shall be approved by the Architect and shall be made without additional cost to the Owner. The Contractor shall be held

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responsible for damage caused to existing services. Promptly notify the Architect if services are found which are not shown on Drawings.

1.15 WARRANTY

- A. Refer to Division 01 for warranty requirements, and duration and effective date of Contractor's Standard Guarantee.
- B. Repair or replace defective work, material, or part that appears within the warranty period, including damage caused by leaks.
- C. On failure to comply with warranty requirements within a reasonable length of time after notification is given, Architect/Owner shall have repairs made at Contractor's expense.

1.16 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. NEMA MG 1 - Motors and Generators; 2021.

PART 2 PRODUCTS

2.01 GENERAL

- A. Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.
- B. All sizes, capacities, and efficiency ratings shown are minimum, except that gas capacity is maximum available.
- C. Refer to Division 22 10 00 and 23 80 00 for specific system piping materials.

2.02 MATERIALS

- A. No material installed as part of this Work shall contain asbestos.
- B. California Green Building Code Compliance:
 - 1. HVAC and refrigeration equipment shall not contain CFCs.
 - 2. HVAC and refrigeration equipment shall not contain Halons.

2.03 ELECTRIC MOTORS

- A. General Motor Requirements: Comply with NEMA MG 1 unless otherwise indicated. Comply with IEEE 841 for severe-duty motors.

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. U.S. Motors.
 - b. Century Electric.
 - c. General Electric.
 - d. Lincoln.
 - e. Gould.

- B. Motor Characteristics: Designed for continuous duty at ambient temperature of 40 deg. C and at altitude of 3300 feet above sea level. Capacity and torque shall be sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
 1. Motors exceeding the nameplate amperage shall be promptly replaced at no cost to the Owner. Horsepower shown is minimum and shall be increased as necessary to comply with above requirements. Furnish motors with splash-proof or weatherproof housings, where required or recommended by the manufacturer. Match the nameplate voltage rating with the electrical service supplied. Check Electrical Drawings. Provide a transformer for each motor not wound specifically for system voltage.

- C. Polyphase Motors: NEMA MG 1, Design B, medium induction motor, premium efficiency as defined in NEMA MG 1. Select motors with service factor of 1.15. Provide motor with random-wound, squirrel cage rotor, and permanently lubricated or regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading. Temperature rise shall match insulation rating. Provide Class F insulation.
 1. Multispeed motors shall have separate windings for each speed.

- D. Polyphase Motors with Additional Requirements:
 1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
 2. Motors Used with Variable Frequency Controllers:

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- a. Separately Connected Motors: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - b. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - c. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - d. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - e. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - f. Each motor shall be provided with a shaft grounding device for stray current protection.
3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
- E. Single-Phase Motors:
1. Select motors with service factor of 1.15.
 2. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
 3. Motors for HVAC exhaust, transfer, and supply fans larger than 1/12 hp and smaller than 1 hp shall be the following:
 - a. Electronically Commutated motor (EC type): Motor shall be electronically commutated type specifically designed for applications, with heavy duty ball bearings. The motor shall be speed controllable down to 20% of full speed and 85% efficient at all speeds.
 - 1) Exceptions:

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- (a) Motors in fan-coils and terminal units that operate only when providing heating to the space served.
 - (b) Motors installed in space conditioning equipment certified under California Energy Code Section 110.1 or 110.2.
4. Contractor's Option: Motors scheduled on Drawings as single-phase, and larger than 1/12 hp and smaller than 1 hp, for applications other than HVAC fans, may be EC type.
 5. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
 6. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
 7. Motors 1/20 HP and Smaller: Shaded-pole type.
 8. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.04 MOTOR STARTERS

- A. Square D, Allen Bradley, or equal, in NEMA Type 1 enclosure, unless otherwise specified or required. Minimum starter size shall be Size 1. Provide NEMA 3R enclosure where exposed to outdoors.
- B. Provide magnetic motor starters for all equipment provided under the Mechanical Work. Starters shall be non-combination type. Provide part winding or reduced voltage start motors where shown or as hereinafter specified. Minimum size starter shall be Size 1.
 1. All starters shall have the following:
 - a. Cover mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.
 - b. Ambient compensated thermal overload.
 - c. Fused control transformer (for 120 or 24 volt service).
 - d. Pilot lights, integral with the starters. Starters located outdoors shall be in NEMA IIIIR enclosures.
 2. Where three phase motors are provided for two-speed operation, provide two speed motor starters.

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3. Starters for single-phase motors shall have thermal overloads. NEMA I enclosure for starters located indoors, NEMA IIIIR enclosure for starters located outdoors.
4. Provide OSHA label indicating the device starts automatically.

2.05 STRAINERS

- A. Charles M. Bailey #100A, Armstrong, Muessco, or equal, Fig. 11 "Y" pattern, 125 psi WP minimum, with monel screens with 20 square mesh for 2 inches and smaller and 3/64 inch perforations for 2-1/2 inches and larger. Install all strainers with a blow-off hose valve with hose adapter. Strainer shall have gasketed cover with straight thread.

2.06 GAUGES

- A. Marsh "Series J", U.S. Gage, Danton 800, or equal, with bronze bushed movement and front recalibration. Dials shall be white with black numerals, 3-1/2 inch dial face. Normal reading shall be at mid-scale. Provide a needle valve on each gauge connection. Supply a gauge piped with branch isolation valves across the inlet and outlet of each pump and where shown on the Drawings.
- B. Provide Pete's Plug II, Sisco P/T, or equal, test plug with Nordel core {and gasketed cap}, on inlet and outlet of each coil, boiler, condenser, chiller and heat exchanger and where shown on Drawings.

2.07 THERMOMETERS

- A. Marsh, Taylor, Palmer, or equal, 5 inch diameter bimetal dial, adjustable from face, with adjustable positioner, located to be easily read from normal personnel approach. Normal reading shall be at mid-scale.
 1. Provide extension for insulation.
 2. Provide thermometers with steel bulb chambers and brass separable sockets.
 3. Thermometers for air temperature shall have 8 inch minimum stem.
- B. Provide Ventlock, Durodyne, or equal thermometer test holes at each air conditioning unit, furnace, and make-up air unit, in mixed air and supply air, and at all locations shown or scheduled on the Drawings. Provide two portable thermometers, with sensing connection arranged to suit test connections.
- C. Provide Pete's Plug II, Sisco P/T, or equal, test plug with Nordel core, on inlet and outlet of each coil, boiler, condenser, chiller and heat exchanger and

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provide two digital electronic test thermometers for each range of fluid temperature and where shown on Drawings.

2.08 ACCESS DOORS

- A. Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.
 - 1. All access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.
- B. Access doors shall match those supplied in Division 08 in all respects, except as noted herein.
- C. Provide stainless steel access doors for use in toilet rooms, shower rooms, kitchens and other damp areas. Provide steel access doors with prime coat of baked-on paint for all other areas.
- D. Where panels are located on ducts or plenums, provide neoprene gaskets to prevent air leakage, and use frames to set door out to flush with insulation.
- E. Provide insulated doors where located in internally insulated ducts or casings.
- F. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the Architect when access is required in these areas.
- G. Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.
- H. Manufacturers: Subject to compliance with requirements, available manufacturers offering products which may be incorporated into the Work include Milcor, Karp, Nystrom, or Cesco, equal to the following:
 - 1. Milcor
 - a. Style K (plaster).
 - b. Style DW (gypsum board).
 - c. Style M (Masonry).
 - d. Style "Fire Rated" where required.

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2.09 FLEXIBLE JOINTS

- A. Where indicated on Drawings, provide Metraflex Metrasphere, Style R, Mason Industries, or equal, Spherical Expansion Joints. Provide control units at each expansion joint, arranged to limit both expansion and compression.
- B. Flexible joints at entry points to building shall be Barco Ductile iron, Advanced Thermal Systems, or equal, threaded style with stainless ball and mineral filled seal.

2.10 PIPE GUIDES

- A. Where flexible connections are indicated on Drawings, provide Metraflex style IV, B-Line, or equal, pipe guides in locations recommended by manufacturer. Maximum spacing from flexible connection to first pipe guide is 4 pipe diameters, and maximum spacing from second pipe guide is 14 pipe diameters.

2.11 EQUIPMENT IDENTIFICATION

- A. Identify each piece of equipment with a permanently attached engraved bakelite plate, 1/2 inch high white letters on black background.

2.12 PIPE IDENTIFICATION

- A. Identify each piping system and indicate the direction of flow by means of Seton, Inc., Marking Services Inc., Reef Industries, Inc., or equal, pre-tensioned, coiled semi-rigid plastic pipe labels formed to circumference of pipe, requiring no fasteners or adhesive for attachment to pipe.
- B. The legend and flow arrow shall conform to ASME A13.1.

PART 3 EXECUTION

3.01 EXISTING MATERIALS:

- A. Remove existing equipment, piping, wiring, construction, etc., which interferes with Work of this Contract. Promptly return to service upon completion of work in the area. Replace items damaged by Contractor with new material to match existing.
- B. Removed materials which will not be re-installed and which are not claimed by Owner shall become the property of Contractor and shall be removed from the Project site. Consult Owner before removing any material from the Project site. Carefully remove materials claimed by Owner to prevent damage and deliver to Owner-designated storage location.

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- C. Existing piping and wiring not reused and are concealed in building construction may be abandoned in place and all ends shall be capped or plugged. Remove unused piping and wiring exposed in Equipment Rooms or occupied spaces. Material shall be removed from the premises. Disconnect power, water, gas, pump or any other active energy source from piping or electrical service prior to abandoning in place.

3.02 FRAMING, CUTTING, AND PATCHING

- A. Special framing, recesses, chases and backing for Work of this Section, unless otherwise specified, are covered under other Specification Sections.
- B. Contractor is responsible for placement of pipe sleeves, hangers, inserts, supports, and location of openings for the Work.
- C. Cutting, patching, and repairing of existing construction to permit installation of equipment, and materials is the responsibility of Contractor. Repair or replace damage to existing work with skilled mechanics for each trade.
- D. Cut existing concrete construction with a concrete saw. Do not utilize pneumatic devices.
- E. Core openings through existing construction for passage of new piping and conduits. Cut holes of minimum diameter to suit size of pipe and associated insulation installed. Coordinate with building structure, and obtain Structural Engineer's approval prior to coring through existing construction.

3.03 MECHANICAL DEMOLITION

- A. Refer to Division 01 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, dismantle and remove mechanical systems, equipment, and components indicated to be removed. Coordinate with all other trades.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping to remain with same or compatible piping material. Refrigerant system must be evacuated per EPA requirements.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

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5. Equipment to Be Removed: Drain down and cap remaining services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.04 ELECTRICAL REQUIREMENTS

- A. Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the Mechanical Work with the Electrical Work to comply.
- B. Furnish necessary control diagrams and instructions for the controls. Before permitting operation of any equipment which is furnished, installed, or modified under this Section, review all associated electrical work, including overload protection devices, and assume complete responsibility for the correctness of the electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. All equipment and connections exposed to the weather shall be NEMA IIIR with factory-wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.
- C. All line voltage and low voltage wiring and conduit associated with the Temperature Control System are included in this Section. Wiring and conduit shall comply with Division 26.

3.05 PIPING SYSTEM REQUIREMENTS

- A. Drawing plans, schematic and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

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3.06 PRIMING AND PAINTING

- A. Perform priming and painting on the equipment and materials as specified herein.
- B. See Division 09 Painting Section(s) for detailed requirements.
- C. Priming and painting:
 - 1. Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed and painted.
 - a. Black Steel Piping:
 - 1) Primer: One coat gray Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, comparable products by Rust-Oleum, Kelly Moore, or equal.
 - 2) Topcoat: Two coats gray Sherwin-Williams Pro Industrial Waterbased Alkyd Urethane Enamel, comparable products by Rust-Oleum, Kelly Moore, or equal.
 - b. Interior Ductwork: Refer to Division 09 Painting Section(s). Architect shall select paint color.
 - 2. Metal surfaces of items to be jacketed or insulated except ductwork and piping shall be given two coats of primer unless furnished with equivalent factory finish. Items to be primed shall be properly cleaned by effective means free of rust, dirt, scale, grease and other deleterious matter and then primed with the best available grade of zinc rich primer. After erection or installation, all primed surfaces shall be properly cleaned of any foreign or deleterious matter that might impair proper bonding of subsequent paint coatings. Any abrasion or other damage to the shop or field prime coat shall be properly repaired and touched up with the same material used for the original priming.
 - 3. Where equipment is provided with nameplate data, the nameplate shall be masked off prior to painting. When painting is completed, remove masking material.

3.07 EXCAVATING

- A. Perform all excavating required for work of this Section. Provide the services of a pipe/cable locating service prior to excavating activities to determine location of existing utilities.

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- B. Unless shown otherwise, provide a minimum of 2'-6" cover above top of pipe to finished grade for all service piping, unless otherwise noted. Trim trench bottom by hand or provide a 4 inch deep minimum bed of sand to provide a uniform grade and firm support throughout entire length of pipe. For all PVC pipe and for PE gas pipe, bed the pipe in 4 inch sand bed. Pipe bedding materials should be clean crushed rock, gravel or sand of which 100 percent will pass a 1 inch sieve. For pipes that are larger than 10 inches in diameter, at least 95 percent should pass a 3/4 inch sieve, and for pipes 10 inches in diameter or smaller, 100 percent should pass a 1/2 inch sieve. All other materials should have a minimum sand equivalent of 50. Only a small proportion of the native soils will meet these requirements without extensive processing; therefore, importation of pipe bedding materials should be anticipated. Pipe bedding materials shall be compacted in lifts not exceeding 6 inches in compacted thickness. Each lift shall be compacted to not less than 90 percent relative compaction at or above the optimum moisture content, in accordance with ASTM Specification D2940, except that bedding materials graded such 100 percent of the material will pass a No. 200 sieve shall be compacted in 6 inch lifts using a single pass of a flat-plate, vibratory compactor or vibratory drum. Pipe bedding materials should extend at least to the spring line.
- C. Maintain all warning signs, barricades, flares, and red lanterns as required.
- D. For all trenches 5 feet or more in depth, submit copy of permit detailed drawings showing shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation of such trenches. Obtain a permit from the Division of Industrial Safety prior to beginning excavations. A copy of the permit shall be available at the site at all times.

3.08 BACKFILLING

- A. Backfill shall comply with applicable provisions of Division 31 of these Specifications.
- B. Except under existing or proposed paved areas, walks, roads, or similar surfaces, backfill for other types of pipe shall be made using suitable excavated material or other approved material. Place backfill in 8 inch layers, measured before compaction, and compact with impact hammer to at least 90 percent relative compaction per ASTM D2940.
 - 1. Backfill plastic pipe and insulated pipe with sand for a minimum distance of 12 inches above the top of the pipe. Compact using mechanical tamping equipment.

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- C. Entire backfill for excavations under existing or proposed pavements, walks, roads, or similar surfaces, under new slabs on grade, shall be made with clean sand compacted with mechanical tamping equipment vibrator to at least 90 percent relative compaction per ASTM D2940. Remove excess earth. Increase the minimum compaction within the uppermost two feet of backfill to 95 percent.
- D. Replace or repair to its original condition all sod, concrete, asphalt paving, or other materials disturbed by the trenching operation. Repair within the guarantee period as required.

3.09 UNION AND FLANGE INSTALLATION

- A. Install Epco, Nibco, or equal, dielectric unions or flanges at points of connection between copper or brass piping or material and steel or cast iron pipe or material except in drain piping. Bushings or couplings shall not be used.
- B. Install unions in piping NPS 2" and smaller 3 or flanges in piping NPS 2-1/2" and larger whether shown or not at each connection to all equipment and tanks, and at all connections to all automatic valves, such as temperature control valves.
- C. Locate the unions for easy removal of the equipment, tank, or valve.
- D. Do not install unions or flanges in refrigerant piping systems.

3.10 ACCESS DOOR INSTALLATION

- A. Furnish and install access doors wherever required whether shown or not for easy maintenance of mechanical systems; for example, at concealed valves, strainers, traps, cleanouts, dampers, motors, controls, operating equipment, etc. Access doors shall provide for complete removal and replacement of equipment.

3.11 CONCRETE WORK

- A. Concrete work required for work of this Section shall be included under another section of the Specification, unless otherwise noted, including poured-in-place concrete work for installing precast manholes, catch basins, etc., and shall include reinforced concrete bases for pumps, tanks, compressors, fan units, boilers, unless the work is specifically indicated on the Drawings to be furnished under this Section.
- B. Underground anchors, and pads for valve access boxes are included under this Section of the Specification. Concrete shall be 3000 psi test minimum. Refer to Division 03 for concrete types.

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3.12 PIPE PROTECTION

- A. Wrap bare galvanized and black steel pipe buried in the ground and to 6" above grade, including piping in conduit, with one of the following, or equal:
 - 1. Polyethylene Coating: Pressure sensitive polyethylene coating, "X-Tru-Coat" as manufactured by Pipe Line Service Corporation or "Green Line" wrap as manufactured by Royston Products, or equal.
 - a. Field Joints and Fittings: Protecto Wrap #1170 tape as manufactured by Pipe Line Service Corporation, or Primer #200 tape by Royston Products, or equal. Installation shall be as per manufacturer's recommendation and instructions.
 - 2. Tape Wrap: Pressure-sensitive polyvinyl chloride tape, "Transtex #V-10 or V-20", "Scotchwrap 50", Slipknot 100, PASCO Specialty & Mfg., Inc., or equal, with continuous identification. Tape shall be a minimum of 20 mils thick for fittings and irregular surfaces, two wraps, 50 percent overlap, 40 mils total thickness. Tape shall be laminated with a suitable adhesive; widths as recommended by the manufacturer for the pipe size. Wrap straight lengths of piping with an approved wrapping machine.
- B. Field Joints: Valves and Fittings: double wrap polyvinyl chloride tape as above. Provide at least two thicknesses of tape over the joint and extend a minimum of 4 inches over adjacent pipe covering. Build up with primer to match adjacent covering thickness. Width of tape of fittings shall not exceed 3 inches. Tape shall adhere tightly to all surfaces of the fittings without air pockets.
- C. Testing: Test completed wrap of piping, including all epoxy painted piping with Tinker and Rasor Co. holiday detector, or equal.
- D. Cleaning: Clean all piping thoroughly before wrapping.
 - 1. Inspection: Damaged or defective wraps shall be repaired as directed. No wrapped pipe shall be covered until approved by Architect.
- E. Covering: No rocks or sharp edges shall be backfilled against the wrap. When backfilling with other than sand, protect wrap with an outer wrapping of Kraft paper; leave in place during backfill.

3.13 PIPE IDENTIFICATION

- A. Provide temporary identification of each pipe installed, at the time of installation. Temporary identification shall be removed and replaced with permanent identification as part of the work.

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- B. Apply the legend and flow arrow at all valve locations; at all points where the piping enters or leaves a wall, partition, cluster of piping or similar obstruction, at each change of direction, and at approximately 20'-0" intervals on pipe runs. Variations or changes in locations and spacing may be made with the approval of the Architect. There shall be at least one marking in each room. Markings shall be located for maximum visibility from expected personnel approach.
 - 1. Apply legend and flow arrow at approximately 10'-0" intervals in science classrooms and science prep rooms.
- C. Wherever two or more pipes run parallel, the markings shall be supplied in the same relative location on each.
- D. Each valve on non-potable water piping shall be labeled with a metal tag stamped "DANGER -- NON-POTABLE WATER" in 1/4 inch high letters.
- E. Apply the markings after painting and cleaning of piping and insulation is completed.

3.14 EXPANSION ANCHORS IN HARDENED CONCRETE

- A. Qualification Tests: The specific anchor shall have a current ICC-ES report and evaluated in cracked concrete in accordance with Acceptance Criteria AC193. If the specific anchor satisfies cyclic testing requirements per Acceptance Criteria AC01, Section 5.6, the full allowable shear and tension loads listed in the current ICC-ES report and manufacturer's recommendations for the specific anchor may be used. Otherwise, the design shear and tension loads shall not be more than 80% of the listed allowable shear and tension loads for the specific anchor.
- B. Installation: The anchors must be installed in accordance with the requirements given in ICC Research Committee Recommendations for the specific anchor.
- C. Testing: Fifty percent of the anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of a special inspector.
- D. The load may be applied by any method that will effectively measure the tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor or calibrated spring-loading devices. Anchors in which the torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.

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3.15 PIPING SYSTEM PRESSURE TESTING

A. General:

1. Perform operational tests under simulated or actual service conditions.
2. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

B. Piping Systems: Test the installations in accordance with the following requirements and applicable codes:

1. Notify the Architect at least seven days in advance of testing.
2. Authority having jurisdiction shall witness tests of piping systems.
3. Piping shall be tested at completion of roughing-in, or at other times as directed by the Architect.
4. Furnish necessary materials, test pumps, gases, instruments and labor required for testing.
5. Isolate from system equipment that may be damaged by test pressure.
6. Make connections to existing systems with flanged connection. During testing of new work, provide a slip-in plate to restrict test pressure to new systems. Remove plate and make final connection to existing system at completion of testing.
 - a. Authority having jurisdiction shall witness final connection to system.

C. Test Schedule: No loss in pressure or visible leaks shall show after four hours at the pressures indicated.

System Tested	Test Pressure PSI	Test With
All Hot, Chilled, Combination, Condenser Water Piping	Greater of 1-1/2 x WP or 100 psi	Water

D. Testing, Evacuating, Charging and Lubrication of Refrigeration Systems:

1. Pressurize with dry nitrogen and/or refrigerant to 300 psig and test all joints with an electronic detector or halide torch. Release the pressure and attach a high vacuum pump. Evacuate to 4 mm (4000 microns) and hold for 30 minutes. Break to 5 psig with dry nitrogen and allow to remain in the system for ten minutes. Evacuate to 2 mm (2000 microns) and hold for 30 minutes. Use a mercury manometer or electronic vacuum gauge. Do not start timing until recommended vacuum range is reached.

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2. At the end of the evacuation, if the system has been proved leak-free, charge with refrigerant and fill the crankcase to the oil level specified by the manufacturer. All refrigerant oil shall be delivered to the location in sealed containers.
3. Replenish for a period of one year without cost to the Owner all refrigerant and oil required to maintain the proper levels.

3.16 TRACER WIRE INSTALLATION

- A. Provide tracer wire for non-metallic water pipe in ground outside of buildings. Use AWG #14 tracer wire with blue colored low density high molecular weight polyethylene insulation, and lay continuously on pipe so that it is not broken or stressed by backfilling operations. Secure wire to the piping with tape at 18 inch intervals. Solder all joints.
- B. Terminals: Precast concrete box and cast iron locking traffic cover, Brooks 3TL, or equal; cover marked with name of service; 6 inches of loose gravel below box. Plastic terminal board with brass bolts; identify line direction with plastic tags. Test for continuity between terminals, after backfilling, in presence of Inspector.
- C. Alternate: Use electronically detectable plastic tape with metallic core, Terra Tape D, manufactured by Reef Industries, Inc., Seton, Inc., Marking Services, Inc., or equal; tape 2 inches wide, continuously imprinted "CAUTION WATER (GAS, etc.) LINE BELOW". Install, with printed side up, directly over pipe, 18 inches below finish grade. Backfill material shall be as previously specified for the particular condition where pipe is installed, but avoid use of crushed rock or of earth with particles larger than 1/2 inch within the top 12 inches of backfill. Take precautions to insure that tape is not damaged or misplaced during backfill operations. Terminal boxes not required.

3.17 OPERATION OF SYSTEMS

- A. Do not operate any mechanical equipment for any purpose, temporary or permanent, until all of the following has been completed:
 1. Complete all requirements listed under "Check, Test and Start Requirements."
 2. Ductwork and piping has been properly cleaned. Piping systems shall be flushed and treated prior to operation.
 3. Filters, strainers etc. are in place.

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4. Bearings have been lubricated, and alignment of rotating equipment has been checked.
 5. Equipment has been run under observation, and is operating in a satisfactory manner.
- B. Provide test and balance agency with one set of Contract Drawings, Specifications, Addenda, Change orders issued, applicable shop drawings and submittals and temperature control drawings.
- C. Operate every fire damper, smoke damper, combination smoke and fire damper under normal operating conditions. Activate smoke detectors as required to operate the damper, stage fan, etc. Provide written confirmation that all systems operate in a satisfactory manner.

3.18 TEMPORARY HEAT

- A. The General Contractor will provide for all temporary heat at such times as may be required or directed by the Architect and pay all fuel and energy costs incurred.
- B. Temporary heating facilities proposed for use by the Contractor will be subject to review of the Architect. Prior to use of any equipment for temporary heat, install temporary filters on all return air inlets, to preclude dust and construction debris from entering the duct system. In addition, install filters in air handling units, and replace at the completion of temporary operation.
- C. Filters used for temporary operation of systems shall be as specified for permanent filters specified herein.
- D. Comply with Check, Test and Start Requirements for start-up of equipment prior to operation for temporary heat.
- E. Contractor shall complete the permanent heating system as soon as possible, thereby making it available for temporary heat. When available, the system may be used as required at the direction of the Architect after systems are properly prepared for use as specified elsewhere. Contractor shall then be responsible for operating the system during periods required and the General Contractor shall pay the fuel and energy costs incurred. Operation of the heating system prior to the filing of "notice of completion" shall not change the Guarantee provisions in any way.]

3.19 CHECK, TEST AND START REQUIREMENTS

- A. An authorized representative of the equipment manufacturer shall perform check, test and start of each piece of mechanical equipment. The

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representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the check test and start of the equipment.

1. As part of the submittal process, provide a copy of each manufacturer's printed startup form to be used.
 2. Some items of specified equipment may require that check, test and start of equipment must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
 3. Provide all personnel, test instruments, and equipment to properly perform the check, test and start work.
 4. When work has been completed, provide copies of reports for review, prior to final observation of work.
- B. Provide copies of the completed check, test and start report of each item of equipment, bound with the Operation and Maintenance Manual.
- C. Upon completion of the work, provide a schedule of planned maintenance for each piece of equipment. Indicate frequency of service, recommended spare parts (including filters and lubricants), and methods for adjustment and alignment of all equipment components. Provide a copy of the schedule with each Operation and Maintenance Manual. Provide a copy of certification from the Owner's representative indicating that they have been properly instructed in maintenance requirements for the equipment installed.

3.20 PRELIMINARY OPERATIONAL REQUIREMENTS AND TESTS

- A. Prior to observation to determine final acceptance, put HVAC, plumbing, and fire protection systems into service and check that work required for that purpose has been done, including but not limited to the following condensed check list. Provide indexed report to tabulating the results of all work.
1. All equipment has been started, checked, lubricated and adjusted in accordance with the manufacturer's recommendations, including modulating power exhausts if present.
 2. Correct rotation of motors and ratings of overload heaters are verified.
 3. Specified filters are installed and spare filters have been turned over to Owner.

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4. All manufacturers' certificates of start-up specified have been delivered to the Owner.
 5. All equipment has been cleaned, and damaged painted finishes touched up.
 6. Damaged fins on heat exchangers have been combed out.
 7. Missing or damaged parts have been replaced.
 8. Flushing and chemical treatment of piping systems has been completed and water treatment equipment, where specified, is in operation.
 9. Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.
 10. Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop instructions have been posted.
 11. Preliminary test and balance work is complete, and reports have been forwarded for review.
 12. Automatic control set points are as designated and performance of controls checks out to agree with the sequence of operation.
 13. Operation and Maintenance Manuals have been delivered and instructions to the operating personnel have been made.
- B. Prior to the observation to determine final acceptance, operate all mechanical systems as required to demonstrate that the installation and performance of these systems conform to the requirements of these specifications.
1. Operate and test all mechanical equipment and systems for a period of at least five consecutive 8 hour days to demonstrate the satisfactory overall operation of the project as a complete unit.
 2. Include operation of heating and air conditioning equipment and systems for a period of not less than two 8 hour days at not less than 90 percent of full specified heating and cooling capacities in tests.
 3. Commence tests after preliminary balancing and adjustments to equipment have been checked. Immediately before starting tests, install air filters and lubricate all running equipment. Notify the Architect at least seven calendar days in advance of starting the above tests.

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4. During the test period, make final adjustments and balancing of equipment, systems controls, and circuits so that all are placed in first class operating condition.
 5. Where Utility District rebates are applicable, demonstrate that the systems meet the rebate program requirements.
- C. Before handing over the system to Owner replace all filters with complete new set of filters.
- D. Review of Contractor's Tests:
1. All tests made by the Contractor or manufacturers' representatives are subject to observation and review by the Owner. Provide timely notice prior to start of each test, in order to allow for observation of testing. Upon the completion of all tests, provide a letter to confirm that all testing has been successful.
- E. Test Logs:
1. Maintain test logs listing the tests on all mechanical systems showing dates, items tested, inspectors' names, remarks on success or failure of the tests.
- F. Preliminary Operation:
1. The Owner reserves the right to operate portions of the mechanical system on a preliminary basis without voiding the guarantee.
- G. Operational Tests:
1. Before operational tests are performed, demonstrate that all systems and components are complete and fully charged with operating fluid and lubricants.
 2. Systems shall be operable and capable of maintaining continuous uninterrupted operation during the operating and demonstration period. After all systems have been completely installed, connections made, and tests completed, operate the systems continuously for a period of five working days during the hours of a normal working day.
 3. This period of continuous systems operation may be coordinated with the removal of Volatile Organic Compounds (VOCs) from the building prior to occupancy should the Owner decide to implement such a program.
 4. Control systems shall be completely operable with settings properly calibrated and adjusted.

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5. Rotating equipment shall be in dynamic balance and alignment.
6. If the system fails to operate continuously during the test period, the deficiencies shall be corrected and the entire test repeated.

H. Pre-Occupancy Building Purge:

1. Prior to occupancy, ventilate the building on 100 percent outside air, 100 percent exhaust for a continuous period determined by a qualified industrial hygienist (engaged by the Contractor) to reduce V.O.C's prior to occupancy.
2. Submit report by the industrial hygienist verifying satisfactory completion of the pre-occupancy purge.

3.21 DEMONSTRATION AND TRAINING

- A. An authorized representative of the equipment manufacturer shall train Owner-designated personnel in maintenance and adjustment of equipment. The representative may be an employee of the equipment manufacturer, or a manufacturer-certified contractor. Submit written certification from the manufacturer stating that the representative is qualified to perform the Owner training for the equipment installed.
1. As part of the submittal process, provide a training agenda outlining major topics and time allowed for each topic.
 2. Some items of specified equipment require that training must be performed by the manufacturer, using manufacturer's employees. See specific equipment Articles in these Specifications for this requirement.
 3. Contractor shall provide three copies of certification by Contractor that training has been completed, signed by Owner's representative, for inclusion in Operation and Maintenance Manual. Certificates shall include:
 - a. Listing of Owner-designated personnel completing training, by name and title.
 - b. Name and title of training instructor.
 - c. Date(s) of training.
 - d. List of topics covered in training sessions.

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4. Refer to specific equipment Articles for minimum training period duration for each piece of equipment.

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SECTION 23 05 53 - MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.02 RELATED REQUIREMENTS

- A. Refer to the General Conditions, Special Conditions and Division 1 General Requirements. The requirements of these sections apply to this section.
- B. Section 09 90 00 - Paints and Coatings: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.04 SUBMITTALS

- A. See Section 00 72 00 - Submittals, for submittal procedures.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Seton Identification Products: www.seton.com/aec.

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2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: Equipment, control panels 1 inch.
 - 3. Letter Height: Thermostats and small control components, 1/4 inch.
 - 4. Background Color: Black.

2.03 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. Ductwork: Minimum 1-1/4" high letters.
 - 2. Access Doors and Similar Operational Instructions: Minimum 3/4" high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

2.05 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- D. Service Markers: Identify buried plugged or capped pipe with concrete marker, 4-inch diameter by 30 inches long, set flush with grade. Provide engraved brass nameplate identifying pipe stub.

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PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 90 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify domestic hot water heating equipment, including water heaters, pumps, expansion tanks, etc. with plastic nameplates.
- G. Identify air conditioning units, makeup air units and exhaust fans with plastic nameplates.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to fan unit and/or zone unit with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- M. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

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- N. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

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SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
2. Balancing Domestic Water Piping Systems.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCES AND STANDARDS

- A. Associated Air Balance Council (AABC)
1. National Standards for Total System Balance, latest edition.
- B. National Environmental Balancing Bureau (NEBB)
1. Procedural Standards for Testing and Balancing of Environmental Systems, latest edition.

1.04 DEFINITIONS

- A. The intent of this Section is to use the standards pertaining to the TAB specialist engaged to perform the Work of this Contract, with additional requirements specified in this Section. Contract requirements take precedence over corresponding AABC or NEBB standards requirements. Differences in terminology between the Specifications and the specified TAB organization standards do not relieve the TAB entity engaged to perform the Work of this Contract of responsibility from completing the Work as described in the Specifications.
- B. Similar Terms: The following table is provided for clarification only:

Similar Terms

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Contract Term	AABC Term	NEBB Term
TAB Specialist	TAB Agency	NEBB Certified Firm
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems
TAB Field Supervisor	Test and Balance Engineer	Test and Balance Supervisor

- C. AABC: Associated Air Balance Council.
- D. NEBB: National Environmental Balancing Bureau.
- E. TAB: Testing, adjusting, and balancing.
- F. TAB Organization: Body governing practices of TAB Specialists.
- G. TAB Specialist: An entity engaged to perform TAB Work.

1.05 ACTION SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.

1.06 INFORMATIONAL SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
 - 1. Provide list of similar projects completed by proposed TAB field supervisor.
 - 2. Provide copy of completed TAB report, approved by mechanical engineer of record for a completed project with similar system types and of similar complexity.
- C. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
 - 1. Submit examinations report with qualifications data.

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- D. 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.
- E. Interim Reports. Submit interim reports as specified in Part 3. Include list of system conditions requiring correction and problems not identified in Contract Documents examination report.
- F. Certified TAB reports.
 - 1. Provide three printed copies of final TAB report. Provide one electronic file copy in PDF format.
- 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.
 - a. Instruments to be used for testing and balancing shall have been calibrated within a period of one year, or less if so recommended by instrument manufacturer and be checked for accuracy prior to start of work.

1.07 CLOSEOUT SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Certified TAB reports, for inclusion in Operation and Maintenance Manual.

1.08 QUALITY ASSURANCE

- A. Independent TAB Specialist Qualifications: Engage a TAB entity certified by AABC or NEBB.
 - 1. The certification shall be maintained for the entire duration of TAB work for this Project. If TAB specialist loses certification during this period, the Contractor shall immediately notify the Architect and submit another TAB

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specialist for approval. All work specified in this Section and in other related Sections performed by the TAB specialist shall be invalidated if the TAB specialist loses certification, and shall be performed by an approved successor.

- B. To secure approval for the proposed TAB specialist, submit information certifying that the TAB specialist is either a first tier subcontractor engaged and paid by the Contractor, or is engaged and paid directly by the Owner. TAB specialist shall not be affiliated with any other entity participating in Work of this Contract, including design, furnishing equipment, or construction. In addition, submit evidence of the following:
 - 1. TAB Field Supervisor: Full-time employee of the TAB specialist and certified by AABC or NEBB.
 - a. TAB field supervisor shall have minimum 10 years supervisory experience in TAB work.
 - 2. TAB Technician: Full-time employee of the TAB specialist and who is certified by AABC or NEBB as a TAB technician.
 - a. TAB technician shall have minimum 4 years TAB field experience.
- C. TAB Specialist engaged to perform TAB work in this Project shall be a business limited to and specializing in TAB work, or in TAB work and Commissioning.
- D. TAB specialist engaged to perform TAB work shall not also perform commissioning activities on this Project.
- E. Certified TAB field supervisor or certified TAB technician shall be present at the Project site at all times when TAB work is performed.
 - 1. TAB specialist shall maintain at the Project site a minimum ratio of one certified field supervisor or technician for each non-certified employee at times when TAB work is being performed.
- F. Contractor shall notify Architect in writing within three days of receiving direction resulting in reduction of test and balance scope or other deviations from Contract Documents. Deviations from the TAB plan shall be approved in writing by the mechanical engineer of record for the Project.
- G. TAB Standard:

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1. Perform TAB work in accordance with the requirements of the standard under which the TAB agencies' qualifications are approved unless Specifications contain different or more stringent requirements:
 - a. AABC National Standards for Total System Balance, or
 - b. NEBB Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 2. All recommendations and suggested practices contained in the TAB standard are mandatory. Use provisions of the TAB standard, including checklists and report forms, to the extent to which they are applicable to this Project.
 3. Testing, adjusting, balancing procedures, and reporting required for this Project, and not covered by the TAB standard applicable to the TAB specialist engaged to perform the Work of this Contract, shall be submitted for approval by the design engineer.
- H. TAB Conference: Meet with Architect and mechanical engineer on approval of the TAB strategies and procedures plan to develop a mutual understanding of the project requirements. Require the participation of the TAB field supervisor. Provide seven days' advance notice of scheduled meeting time and location. TAB conference shall take place at location selected by Architect offices of Capital.
1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow, including protocol for resolution tracking and documentation.
 2. The requirement for TAB conference may be waived at the discretion of the mechanical engineer of record for the Project.
- I. Certify TAB field data reports and perform the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

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2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

- J. TAB Report Forms: Use standard TAB specialist's forms approved by Architect.

- K. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

- L. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

- M. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.09 PROJECT 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.

1.10 WARRANTY

- A. Provide workmanship and performance warranty applicable to TAB specialist engaged to perform Work of this Contract:
 1. AABC Performance Guarantee.
 2. NEBB Quality Assurance Program.

- B. Refer to Division 01 Specifications for additional requirements.

1.11 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

- C. Coordinate TAB work with work of other trades.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Contract Documents Examination Report:

LP Consulting Engineers, Inc.

LPCE Project #: 24-2001

TESTING, ADJUSTING, AND BALANCING
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1. TAB specialist shall review Contract Documents, including plans and specifications. Provide report listing conditions that would prevent the system(s) from operating in accordance with the sequence of operations specified, or would prevent accurate testing and balancing:
 - a. Identify each condition requiring correction using equipment designation shown on Drawings. Provide room number, nearest building grid line intersection, or other information necessary to identify location of condition requiring correction.
 - b. Proposed corrective action necessary for proper system operation.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves.
 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

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- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine operating safety interlocks and controls on HVAC equipment.
- O. Report conditions requiring correction discovered before and during performance of TAB procedures.
- P. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures. TAB plan shall be specific to Project and include the following:
 - 1. General description of each air system and sequence(s) of operation.
 - 2. Complete list of measurements to be performed.
 - 3. Complete list of measurement procedures. Specify types of instruments to be utilized and method of instrument application.
 - 4. Qualifications of personnel assigned to Project.
 - 5. Single-line CAD drawings reflecting all test locations (terminal units, grilles, diffusers, traverse locations, etc).
 - 6. Table indicating pressure relationships (positive, negative, or neutral) between building spaces.
 - 7. Air terminal correction factors for the following:
 - a. Air terminal configuration.
 - b. Flow direction (supply or return/exhaust).
 - c. Effective area of each size and type of air terminal.
 - d. Air density.

- B. Complete system-readiness checks and prepare reports. Verify the following:

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1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation." Section 23 80 00 Heating, Ventilating, and Air Conditioning."
- 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.

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- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Test each system to verify building or space operating pressure, including all stages of economizer cycle. Maximum building pressure shall not exceed 0.03 inches of pressure.
- C. Except as specifically indicated in this Specification, Pitot tube traverses shall be made of each duct to measure airflow. Pitot tubes, associated instruments, traverses, and techniques shall conform to ASHRAE Handbook, HVAC Applications, and ASHRAE Handbook, HVAC Systems and Equipment.
1. Use state-of-the-art instrumentation approved by TAB specialists governing agency..
 2. Where ducts' design velocity and air quantity are both less than 1000 fpm/CFM, air quantity may be determined by measurements at terminals served.
- D. Test holes shall be placed in straight duct, as far as possible downstream from elbow, bends, take-offs, and other turbulence-generating devices.
- E. For variable-air-volume systems, develop a plan to simulate diversity.
- F. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- G. 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.
- H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- I. Verify that motor starters are equipped with properly sized thermal protection.
- J. Check dampers for proper position to achieve desired airflow path.
- K. Check for airflow blockages.
- L. Check condensate drains for proper connections and functioning.

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- M. Check for proper sealing of air-handling-unit components.
- N. Verify that air duct system is sealed as specified in Section 23 31 13 "Metal Ducts." Section 23 80 00 "Heating, Ventilating, and Air Conditioning."
- O. Provide for adjustments or modifications to fan and motor sheaves, belts, damper linkages, and other components as required to achieve specified air balance at no additional cost to Owner.
- P. Automatically operated dampers shall be adjusted to operate as indicated in Contract Documents. Controls shall be checked for proper calibration.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow. Alternative methods shall be examined for determining total CFM, i.e., Pitot-tube traversing of branch ducts, coil or filter velocity profiles, prior to utilizing airflow values at terminal outlets and inlets.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

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- a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Architect 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.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Check operation of relief air dampers. Measure total relief air quantity at each stage of normal, economizer, power exhaust, or power exhaust economizer operation, as applicable to installed equipment. Adjust relief air dampers to provide 100 percent relief in economizer mode. Ensure that relief dampers close completely upon unit shutdown.
- C. Check operation of outside air dampers. Measure total outside air quantity at each stage of normal, economizer, power exhaust, or power exhaust economizer operation, as applicable to installed equipment. Adjust outside air dampers to provide 100 percent outside air in economizer mode. Ensure that outside air dampers close completely upon unit shutdown.
- D. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

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2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- E. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading digital backflow compensating hood. Use outlet manufacturer's written instructions and calculating factors only when direct-reading hood cannot be used due to physical obstruction or other limiting factors. Final report shall indicate where values listed have not been obtained by direct measurement.
- F. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents, if included.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts. Terminal air velocity at five feet above finished floor shall not exceed 50 feet per minute in occupied air conditioned spaces.
- G. Do not overpressurize ducts.

3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Comply with applicable requirements for constant-volume air systems in addition to those listed below.
- B. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- C. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

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1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure 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.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data including optimum operating static control set point.

3.07 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer's name, model number, and serial number.

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2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter manufacturer's name, model number, size, type, and thermal-protection-element rating.
 - a. Starter strip heater size, type, and rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.08 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the condition of filters.
 4. Check the condition of coils.
 5. Check the operation of the drain pan and condensate-drain trap.
 6. Check bearings and other lubricated parts for proper lubrication.
 7. Report on the operating condition of the equipment and the results of the measurements taken. Report conditions requiring correction.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

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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. Conditions requiring correction 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 air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 4. Balance each air outlet.

3.09 GENERAL PROCEDURES FOR PLUMBING SYSTEMS

- A. Measure pressure drop across each backflow preventer assembly at design flows.
- B. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

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- a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect Owner Construction Manager Commissioning Authority and comply with requirements in Section 22 50 00 "Plumbing Equipment Section 22 11 23 "Domestic Water Pumps."
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within range given in article, Tolerances.
- C. Set calibrated balancing valves, if installed, at calculated presetsings.
- D. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- E. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- F. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.

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- G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- H. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- I. Check settings and operation of each safety valve. Record settings.

3.10 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: 10.
 - 2. Air Outlets and Inlets: 10.
 - 3. Multiple outlets within single room: 10 for total airflow within room. Tolerance for individual outlets within a single room having multiple outlets shall be as for "Air Outlets and Inlets".
 - 4. Heating-Water Flow Rate: 10.
 - 5. Cooling-Water Flow Rate: 10.
- B. Set plumbing systems water flow rates within plus or minus 10 percent.

3.11 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Interim Reports: Prepare periodic lists of conditions requiring correction 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.

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3.12 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 field supervisor. Report shall be co-signed by the Contractor, attesting that he has reviewed the report, and the report has been found to be complete and accurate.
 - 2. The certification sheet shall be followed by sheet(s) listing items for which balancing objectives could not be achieved. Provide explanation for failure to achieve balancing objectives for each item listed.
 - 3. Include a list of instruments used for procedures, along with proof of calibration.

- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.

- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB specialist.
 - 3. Project name.
 - 4. Project location.
 - 5. Project Performance Guaranty
 - 6. Architect's name and address.
 - 7. Engineer's name and address.

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8. Contractor's name and address.
 9. Report date.
 10. Signature of TAB supervisor who certifies the report.
 11. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 12. 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.
 13. Nomenclature sheets for each item of equipment.
 14. Data for terminal units, including manufacturer's name, type, size, and fittings.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.

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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 distribution outlets and inlets shall be shown on keyed plans with designation for each outlet and inlet matching designation used in Contract Documents and TAB test reports. Room numbers shall be included in keyed plans and test reports. Where multiple outlets and inlets are installed within a single room, a designation shall be assigned and listed for each outlet and inlet in addition to room number.
- F. Test Reports – General:
1. All test reports containing air or liquid flow data shall record flow values prior to system adjustment in addition to required data listed for each test report.
- G. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.

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- 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 rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
- a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Relief airflow in cfm.
 - l. Outdoor-air damper position, normal and economizer, power exhaust, or power exhaust economizer modes, as applicable to installed equipment.
 - m. Return-air damper position.

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- n. Relief-air damper position, normal and economizer, power exhaust, or power exhaust economizer modes, as applicable to installed equipment.
- o. Vortex damper position.

H. 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. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.

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- j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - l. Refrigerant expansion valve and refrigerant types.
- I. 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 rpm.
 - 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 air flow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.

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- 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.
- J. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):

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- a. Heat output in Btu/h.
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- K. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

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- g. Number, make, and size of belts.
- 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- L. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- M. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.

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- c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
2. Test Data (Indicated and Actual Values):
- a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- N. 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):
 - a. Air flow rate in cfm.

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- 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.
- O. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
- 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):

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- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

P. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.13 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.

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- b. Measure water flow of at least 5 percent of terminals.
- c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
- d. Verify that balancing devices are marked with final balance position.
- e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

- 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
- 2. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.
- 3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than 10 percent, the measurements shall be noted as "FAILED."
- 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

- 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
- 2. If the second final inspection also fails, Owner may contact the TAB specialists' governing organization for remedial action by the governing organization under the workmanship and performance warranty. See article, Warranty.
- 3. If remedial action is not provided by the TAB specialists' governing organization in a timely manner, Owner may contract the services of

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another TAB specialist to complete the TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB specialists' final payment.

D. Prepare test and inspection reports.

3.14 ADDITIONAL TESTS

A. 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

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SECTION 23 09 23 - ENERGY MANAGEMENT CONTROL SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION OF WORK:

- A. Refer to Basic Mechanical Requirements Section, for general mechanical requirements.
- B. Refer to Mechanical Division for installation of instrument wells, valve bodies, dampers, etc. in mechanical systems.
- C. Provide the following electrical work as work of this Section, complying with requirements of Electrical Division, and as outlined below:
 - 1. All control wiring between field-installed controls, indicating devices, and unit control panels.
 - 2. Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated.
 - 3. Wiring associated with indicating and alarm panels (remote alarm panels) and connections to their associated field devices.
 - 4. Contractor shall provide and extend low voltage power source wiring required for operation of control devices provided.
 - 5. Wiring for fully complete and functional controls system and as specified.

1.02 SUBMITTALS: IN ACCORDANCE WITH DIVISION 1

- A. Product Data: Submit manufacturer's specifications for each control device furnished, including installation instructions and start-up instructions. Submit integrated wiring and electrical diagram to show complete system operation.
- B. All submittals must be received and approved by the Owner prior to the ordering and installation of any equipment by the Contractor.
 - 1. Provide the Owner with a Building Controls submittal with the following:
 - a. System Hardware
 - b. System Architecture
 - c. Complete System Wiring Schematic

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- C. Submit shop drawings showing construction and mounting details for review prior to construction. In addition, submit the following for review prior to panel and/or system fabrication and installation:
1. Field wiring diagrams showing wiring external to panel.
 2. Panel internal wiring diagrams also showing panel terminal connections for external wiring, properly coordinated and keyed to external wiring diagram.
 3. Designation of all switches, pilot lights, etc. and layout of instruments, switches, and nameplates of panel.

1.03 COORDINATION:

- A. Automatic temperature control systems work shall be accomplished as outlined below:
1. Control Valves furnished under this section shall be installed as specified in Mechanical Division.
 2. Control Dampers are provided under the applicable Mechanical Division air distribution or air handling equipment section.
 3. Water Pressure Taps, Thermal Wells, Flow Switches, Flow Meters, that will have wet surfaces furnished under this Section, shall be installed as specified in Mechanical Division.
 4. Controlled Equipment Power Wiring shall be furnished and installed under Electrical Division. Where control involves 120V control devices controlling 120V equipment, the Division 16 Electrical Contractor shall extend power wiring to the equipment and shall extend it from the equipment to the control device.

1.04 INSTALLING CONTRACTOR QUALIFICATIONS:

- A. The Building Automation System Control System contractor must have been in business, and licensed as a contractor by the State of California, installing HVAC and building automation controls, and fire/life safety systems, for a minimum of ten (10) years preceding the bid opening.
- B. The Building Automation Control System contractor must have completed no less than one (1) control system installation, within twenty-four (24) months preceding the bid opening, pursuant to a single written contract, valued at no less than three hundred thousand (\$300,000) dollars.

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- C. The Building Automation Control System contractor must demonstrate that, from the local office that will service the Owner with a four (4) hour emergency response requirement can logistically be provided.
- D. Controls contractor must have direct access to factory certified instructors to provide training upon request of the district.
- E. Controls contractor must have explicit district approval to interface with district wide server for integration of new controls system.
- F. The Building Automation Control System contractor must have been, for five (5) years preceding the bid opening, a factory branch office, or a factory authorized dealer for the product manufacturer type identified in subsection 2.01, A., under PART 2 – PRODUCTS, of this section. Factory authorized dealer means:
 - 1. Installing Contractor has a contract directly with the factory. Approved installing contractors shall be Johnson Controls (JCI), Emcor, or Intech Mechanical. No others are approved.

PART 2 PRODUCTS

2.01 GENERAL:

- A. Manufacturer: The Building Automation Control System shall be provided by the following:
 - 1. Controls are to be provided by Johnson Controls, Inc., branch office in Folsom, CA to match campus standard.
 - 2. No other contractors are acceptable or will be considered per Part 1.4, Item F above.
 - 3. The Building Automation Controls contractor must have been, for ten (10) years preceding the bid opening, a factory branch office. A contract with a distributor is not acceptable.
- B. All new controls material must be fully integrated and graphically represented on existing district building automation controls system on the districts servers. Only district authorized personnel may access this server for controls integration.
- C. All components used shall be serviceable, repairable, and replaceable by qualified temperature control technicians using non-proprietary parts, tools, and instruments.

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2.02 SUPERVISORY CONTROLLER

A. NETWORK AUTOMATION ENGINE (NAE) – EXISTING ON SITE

1. The NAE shall perform the function of monitoring all system variables, both from real hardware points, software variables, and controller parameters such as set points.
2. NAE's shall be entirely solid state devices. No rigid disk drives will be permitted in the equipment rooms.
3. The NAE's shall manage and direct all information traffic on the Tier 1 network, between the Tier 1 and Tier2 networks, and to servers.
4. Any NAE on the Tier 1 network shall be equipped with all software necessary to drive the complete user interface including graphics on a browser connected to the NAE via the network or directly via a local port on the node.
5. The operating system of the NAE shall support multi-user access. At minimum four users shall be able to access the same NAE simultaneously.
6. Communication between NAE's shall be per-to-peer via 10/100 Ethernet using the BACnet protocol.
7. The NAE shall be capable of direct connection to multiple field busses using different protocols simultaneously as indicated below. Should the controller not support multiple field busses, install two supervisory controllers side by side.
 - a. An RS-485 serial field bus such as BACnet MSTP or the manufacturer's proprietary field bus – JCI N2.
 - b. A LON field bus for supervision and control of LON based controllers that conform to the Lon Talk standard.
8. The NAE will integrate data from both field busses into a common object structure. Data from both field busses will appear in common displays throughout the user interface in exactly the same format. It shall not be possible to determine which field buss the data originated on without reviewing the system configuration data.
9. The NAE shall be programmable and governed by the requirements of their applicable codes, approvals and regulations.

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10. The NAE shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this Project.
11. A failure at an NAE shall not cause failures or non-normal operation at any other system NAE other than the possible loss of active real-time information from the failed NAE.
12. Ancillary NAE equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.
13. The NAE shall comply with FCC Part 15 subpart J class A emission requirements.
14. Each NAE shall be equipped with the necessary un-interruptible power such that it will not cease operation during minor power outages, including those that occur upon transfer to emergency generator or other local power source not provided by the utility.

2.03 NETWORKING/COMMUNICATIONS:

- A. The design of the Building Automation Control System shall network operator workstations and Standalone DDC Panels as shown on the attached system configuration drawing. Inherent in the system's design shall be the ability to expand or modify the network(s) either via the local area network, or auto-dial telephone line modem connections, or via a combination of the two networking schemes.

1. Local Area Network

- a. Workstation/DDC Panel Support: Operator workstations and DDC panels shall directly reside on a local area network such that communications may be executed directly between controllers, directly between workstations, and between controllers and workstations on a peer-to-peer basis.
- b. Dynamic Data Access: All operator devices, either network resident or connected via dial-up modems, shall have the ability to access all point status and application report data, or execute control functions for any and all other devices via the local area network. Access to data shall be based upon logical identification of building equipment. Access to system data shall not be restricted by the hardware configuration of the Building Automation Control System. The hardware configuration of the Building Automation

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Control System network shall be totally transparent to the user when accessing data or developing control programs.

- c. General Network Design: Network design shall include the following provisions:
- 1) High-speed data transfer rates for alarm reporting, quick report generation from multiple controllers and upload/download efficiency between network devices. The minimum baud rate shall be one (1) Megabaud.
 - 2) Support of any combination of controllers and operator workstations directly connected to the local area network. A minimum of fifty (50) devices shall be supported on a single local area network.
 - 3) Detection and accommodation of single or multiple failures of either workstations, DDC panels or the network media. The network shall include provisions for automatically reconfiguring itself to allow all operational equipment to perform their designated functions as effectively as possible in the event of single or multiple failures.
 - 4) Message and alarm buffering to prevent information from being lost.
 - 5) Error detection, correction, and retransmission to guarantee data integrity.
 - 6) Default device definition to prevent loss of alarms or data, and ensure alarms are reported as quickly as possible in the event an operator device does not respond.
 - 7) Commonly available, multiple sourced, networking components and protocols shall be used to allow the Building Automation Control System to coexist with other networking applications such as office automation. MAP, ETHERNET, IBM Token Ring and ARCNET are acceptable technologies.
 - 8) Use of an industry standard IEEE 802.x protocol. Communications must be of a deterministic nature to assure calculable performance under worst-case network loading.
 - 9) Synchronization of the real-time clocks in all DDC panels shall be provided.

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2.04 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS:

- A. Each Standalone DDC Controller shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASCs).
- B. Each ASC shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.
- C. Each ASC shall have sufficient memory to support its own operating system and data base including:
 - 1. Control Processes
 - 2. Energy Management Applications
 - 3. Operator I/O (Portable Service Terminal)
- D. The operator interface to any ASC point data or programs shall be through any network-resident PC workstation, or any PC or portable operator's terminal connected to any DDC panel in the network.
- E. Application Specific Controllers shall directly support the temporary use of a portable service terminal. The capabilities of the portable service terminal shall include but not be limited to the following:
 - 1. Display temperatures
 - 2. Display status
 - 3. Display setpoints
 - 4. Display control parameters
 - 5. Override binary output control
 - 6. Override analog setpoints
 - 7. Modification of gain and offset constants
- F. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the controller.
- G. Application Description:

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1. Field Equipment Controller (FEC) – BY JCI
 - a. When indoors - the FEC shall operate as a standard from 32 to 122 degrees Fahrenheit ambient air temperature and 10 to 90% relative humidity.
 - b. When outdoors mounted either in unit cabinet or mounted in a steel enclosure – the FEC shall operate from -40 to 158 degrees Fahrenheit ambient air temperature and 10 to 90% relative humidity.
 - c. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
 - d. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
 - e. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
 - f. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
 - g. The FEC shall include a removable base to allow pre-wiring without the controller.
 - h. The FEC shall include troubleshooting LED indicators to identify the following conditions:
 - 1) Power On
 - 2) Power Off
 - 3) Download or Startup in progress, not ready for normal operation
 - 4) No Faults
 - 5) Device Fault
 - 6) Field Controller Bus - Normal Data Transmission

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- 7) Field Controller Bus - No Data Transmission
- 8) Field Controller Bus - No Communication
- 9) Sensor-Actuator Bus - Normal Data Transmission
- 10) Sensor-Actuator Bus - No Data Transmission
- 11) Sensor-Actuator Bus - No Communication
- i. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
- j. The FEC shall support the following types of inputs and outputs:
 - 1) Universal Inputs - shall be configured to monitor any of the following:
 - (a) Analog Input, Voltage Mode
 - (b) Analog Input, Current Mode
 - (c) Analog Input, Resistive Mode
 - (d) Binary Input, Dry Contact Maintained Mode
 - (e) Binary Input, Pulse Counter Mode
 - 2) Binary Inputs - shall be configured to monitor either of the following:
 - (a) Dry Contact Maintained Mode
 - (b) Pulse Counter Mode
 - 3) Analog Outputs - shall be configured to output either of the following
 - (a) Analog Output, Voltage Mode
 - (b) Analog Output, current Mode
 - 4) Binary Outputs - shall output the following:
 - (a) 24 VAC Triac
 - 5) Configurable Outputs - shall be capable of the following:
 - (a) Analog Output, Voltage Mode

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(b) Binary Output Mode

- k. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
 - 1) supporting BACnet Standard protocol SSPC-135, Clause 9.
 - 2) The FC Bus shall support communications between the FECs and the NAE.
 - 3) communications with the FEC and with the NAE.
 - 4) The FC Bus shall support a minimum of 100 IOMs and FEC in any combination.
 - 5) The FC Bus shall operate at a maximum distance of 15,000 ft. between the FEC and the furthest connected device.
- l. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
 - 1) supporting BACnet Standard protocol SSPC-135, Clause 9.
 - 2) The SA Bus shall support a minimum of 10 devices per trunk.
 - 3) The SA Bus shall operate at a maximum distance of 1,200 ft. between the FEC and the furthest connected device.
- m. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
- n. The FEC shall support, but not be limited to, the following:
 - 1) Hot water, chilled water/central plant applications
 - 2) Built-up air handling units for special applications
 - 3) Terminal units
 - 4) Special programs as required for systems control

H. Field Devices

- 1. Input/Output Module (IOM) – BY JCI
 - a. The IOM shall operate as a standard from 32 to 122 degrees Fahrenheit ambient air temperature and 10 to 90% relative humidity

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- b. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
- c. The IOM shall communicate with the FEC over either the FC Bus or the SA Bus using BACnet Standard protocol SSPC-135, Clause 9.
- d. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
- e. The IOM shall have a minimum of 4 points to a maximum of 17 points.
- f. The IOM shall support the following types of inputs and outputs:
 - 1) following:
 - (a) Analog Input, Voltage Mode
 - (b) Analog Input, Current Mode
 - (c) Analog Input, Resistive Mode
 - (d) Binary Input, Dry Contact Maintained Mode
 - (e) Binary Input, Pulse Counter Mode
 - 2) Binary Inputs - shall be configured to monitor either of the following:
 - (a) Dry Contact Maintained Mode
 - (b) Pulse Counter Mode
 - 3) Analog Outputs - shall be configured to output either of the following:
 - (a) Analog Output, Voltage Mode
 - (b) Analog Output, current Mode
 - 4) Binary Outputs - shall output the following:
 - (a) 24 VAC Triac
 - 5) Configurable Outputs - shall be capable of the following:
 - (a) Analog Output, Voltage Mode
 - (b) Binary Output Mode

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- g. The IOM shall include troubleshooting LED indicators to identify the following conditions:
 - 1) Power On
 - 2) Power Off
 - 3) Download or Startup in progress, not ready for normal operation
 - 4) No Faults
 - 5) Device Fault
 - 6) Normal Data Transmission
 - 7) No Data Transmission
 - 8) No Communication

- 2. Network Sensors (NS)
 - a. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
 - 1) Zone Temperature
 - 2) Zone humidity
 - 3) Zone setpoint

 - b. The NS shall transmit the zone information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.

 - c. The Network Sensors shall include the following items:
 - 1) A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint.
 - 2) An LED to indicate the status of the Override feature.
 - 3) A button to toggle the temperature display between Fahrenheit and Celsius.
 - 4) A button to initiate a timed override command

 - d. The NS shall be available with either screw terminals or phone jack.

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- e. The NS shall be available in either surface mount or wall mount styles.

2.05 TEMPERATURE CONTROL MATERIAL:

- A. PANEL DEVICES
- B. TRANSDUCERS
- C. SENSORS
- D. FIELD DEVICES
- E. Motorized Control Dampers: Shall be parallel blade for two-position control and opposed blade for proportional control applications. Dampers shall have an enamel finish or be galvanized, with nylon bearings. Blade edge and tip seals shall be included for all dampers. Blade shall be double piece 22 gauge minimum and 8" wide maximum and frame shall be welded channel iron.
- F. Temperature control panels (TCP): Shall be of NEMA code gauge steel with locking doors for mounting all devices as shown. They shall meet all applicable requirements of Title 24, California Code of Regulations. All controllers, relays, switches, etc. for equipment located in mechanical equipment rooms shall be mounted in a TCP as shown on the drawings. Temperature settings, adjustments and calibration shall be done at the TCP. Any required UCMC Campus Data networks connection for this panel shall be installed inside the panel. All electric devices within a control panel shall be factory pre-piped and wired. Provide engraved laminated plastic nameplates identifying all devices mounted on the face of the control panels. A complete set of related "as-builts" control drawings shall be furnished in each control panel.

2.06 GRAPHIC INTERFACE

- A. The following are examples of the district wide standard for the graphical interface of the controls system. The new controls system must be graphically represented according to the following templates
 - 1. District Map View
 - 2. School Overview
 - 3. Zone Overview
 - 4. Equipment Overview

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2.07 CONSULTATIVE SUPPORT

- A. For this project, the manufacturer shall provide at a minimum 8 hours of consultative support services to review and provide recommendations and enhancements to the system, which may include:
 - 1. Review of critical programming loops and adjustments as necessary
 - 2. Adjustments to improve building system operation, reduce energy consumption and/or improve environmental control
 - 3. Implementation or enhancement of functionality in the system

2.08 MISCELLANEOUS DEVICES

- A. Moisture Sensors:
 - 1. Moisture sensors shall be used to detect water in elevator sumps and chilled water fan coil unit overflow drain pans and where otherwise indicated on the Drawings using George Risk Industries Model GRI 2650, Veris MX Series, or equal.
 - 2. The sensor shall be floor mounted operating at 24 VAC with SPDT relay for the output signal with automatic reset.

PART 3 EXECUTION

3.01 GENERAL:

- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Direct Digital Control Building Automation Control System, as shown on the drawings and described herein.
- B. All labor, material, equipment, and software necessary to meet the functional intent of the Building Automation Control System as specified herein and as shown on the drawings shall be included.
- C. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein, or on the plans, that are required to meet the functional intent of the Building Automation Control System, shall be provided without additional cost to Sac City Unified School District.
- D. Equipment furnished by Electrical and/or Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Wiring normally performed in field shall be furnished and installed by the Building Automation Control System contractor.

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- E. Control equipment having electrical connections only, which are furnished under this work, shall be installed and connected by the Building Automation Control System contractor. Electrical devices requiring wet side piping connections shall be installed by the Mechanical Contractor.
- F. Clearly identify and label equipment and controls, such as starters, switches, relays, as to function and position with permanently engraved plastic nameplates.
- G. Wiring of control equipment in accordance with wiring diagrams and functional operation of the control system shall be the responsibility of the Building Automation Control System contractor.
- H. Final Adjustment of Equipment: After completion of installation, adjust temperature sensors, control valves, actuators, motors, and similar equipment provided under the scope of work of this section. Cooperate with the air balance contractor as required.
- I. Perform final adjustment by specially trained personnel in direct employ by the manufacturer of the primary Building Automation Control System.
- J. Connect control valves with threaded connections with sufficient unions to permit valves to be readily removed from their installed locations for servicing, without disturbing adjacent piping. In no case shall this be less than three unions for three-way valves and one union for two-way valves.
- K. Wiring and raceways included with the BACS scope of works includes but is not limited to the following:
 - 1. Power wiring for all controllers, sensors, relays and other equipment shall be taken from the local HVAC controls panels except equipment provided with dedicated supplies provided by Division 16.
 - 2. Controls wiring shall be routed from the local HVAC controls panels.
 - 3. Conduit shall be used for the following:
 - a. All exposed and concealed low voltage wiring in all areas below 8 feet above floor level.
 - b. All mechanical and equipment rooms, exterior locations and any other areas where physical protection and/or access is required as defined elsewhere in the contract documents.
 - c. All in-wall drops to equipment monitoring and/or control points including but not limited to medical equipment, kitchen service

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equipment, elevator sump and other moisture sensors, water flow meters, equipment mounted alarms, etc.

- d. All areas where specifically indicated on the Drawings.
- 4. J-Hooks and or designated LV raceway shall be used for the following:
 - a. All low voltage wiring above 8 feet above floor level in open and accessible areas where conduit is not required, to cable trays or other conduits.
 - b. All areas where specifically indicated on the Drawings.
- 5. Conduit and J-Hook materials and installation requirements shall comply with the applicable sections of Division 16 unless specifically indicated otherwise on the Drawings.

3.02 WARRANTY:

- A. The Building Automation Control System contractor shall provide a one-year warranty covering the Building Automation Control System, and all associated components installed by the Building Automation Control System contractor. Any manufacturing or installation defects arising during this warranty period shall be corrected without cost to the Owner. The Building Automation Control System contractor shall respond to the job site within a four (4) hour period for any emergency relating to the control system and associated components installed by the Building Automation Control System contractor. Warranty period shall commence after all operator instruction is completed and the entire system has been accepted by the Owner.

3.03 CARE AND CLEANING:

- A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Owner's Representative. At completion, carefully clean and adjust equipment, fixtures, and trim installed as part of this work. Leave systems and equipment in satisfactory operating condition.

3.04 OPERATION TEST/SYSTEM COMMISSIONING:

- A. Each piece of equipment shall be tested by the Building Automation Control System contractor to show that it will operate in accordance with designed requirements, and provide written documentation of this test. Control system commissioning shall consist of a point per point conformation and system operational demonstration conducted jointly by the Building Automation Control System contractor and the University's Representative.

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- B. The mechanical contractor and BACS contractor/vendor will conduct two levels of Quality Assurance to verify that the required installation and performance of the Building Automation Control System as been met.
 - 1. Static Commissioning:
 - a. A point to point examination and documentation of the successful installation of the BACS system and its components in its entirety.
 - b. The start up of all HVAC equipment and associated systems will not commence until this work has been completed and the documentation received by the Owner.
 - 2. Dynamic Commissioning:
 - a. A point by point demonstration and documentation of the successful performance of the BACS system and its components in its entirety.
 - b. The verification demonstrations of all HVAC equipment and associated systems will not commence until this work has been completed and the documentation received by the Owner.
- C. All new controller programming shall be backed up into the districts existing database.
- D. As part of the operational test's the controls contractor shall demonstrate integration of new controls system into the existing server and BACS.
- E. In General the Commissioning process will comprise the following:
 - 1. Review of points list and documentation.
 - 2. Installation compliance with project plans and specifications.
 - 3. Point-to-point check.
 - 4. Control devices calibration and operation.
 - 5. System programming and documentation.
 - 6. System endurance test.
 - 7. Control loop trends.
 - 8. Reports and alarms.
 - 9. Analog input calibration.
 - 10. Analog output check and spring ranges.

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11. Digital input range set points.
 12. Digital output in autolog.
 13. Point by point performance verification.
 14. O & M training and documentation.
 15. Opposite season verification and documentation.
 16. Review and document system architecture.
- F. Prior to job closing, the controls contractor must provide and present drawings showing the physical location of the new Field Control bus routing around the campus. This will be reviewed by district HVAC personnel.

3.05 OPERATOR INSTRUCTION:

- A. During system commissioning and at such time acceptable performance of the Building Automation Control System hardware and software has been established, the Control Contractor shall schedule with the Owner's Representative and provide eight (8) hours of on site, or off site, operator instruction to the Owner's operating personnel. Operator instruction during normal working hours shall be performed by a competent representative familiar with the systems hardware, software, and accessories

END OF SECTION

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SECTION 23 80 00 - HEATING, VENTILATING AND AIR CONDITIONING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Roof mounted heat pump units.
2. Fans.
3. Kitchen exhaust hood – type 1.
4. Air inlets and outlets.
5. Terminal Units.
6. Filters.
7. Dampers.
8. Ductwork.
9. Insulation.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 23 00 50, Basic HVAC Materials and Methods.
- C. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- D. Section 23 09 23, Energy Management Control System.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings:

1. Variable Refrigerant Flow System Conference: Installing contractor's foreman shall attend conference at Project site with design Engineer and equipment manufacturer's representative, to comply with requirements of this Section and manufacturer's installation requirements including but not limited to, the following:

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- a. Proposed deviations from system as shown and described in Contract Documents, including location of system components and impacts to refrigerant pipe sizing.
 - 1) Provide Coordinated Layouts as required by this Section for use in discussion.
- b. Refrigerant piping assembly practices.
- c. General discussion, question and answer period.
- d. Walk site with equipment manufacturer's representative to identify conditions affecting installation of system as designed.

1.04 ACTION SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, weight, corner or mounting point weights, furnished specialties and accessories; and installation and start-up instructions. Product data shall include applicable product listings and standards. Refer to Section 23 00 50, Basic HVAC Material and Methods for additional requirements.
 1. Upon approval of submittal, provide manufacturer's installation and operating instructions to the Project inspector for the following:
 - a. Fire dampers, smoke dampers, and combination smoke-fire dampers.
 - b. Type 1 kitchen exhaust field applied grease duct enclosures.
- C. VRF Systems: Submit system documentation for a fully engineered system, including shop drawings, and wiring and control diagrams, showing location of required manufactured system components, component model numbers and capacities, and size and location of all field-installed components, including piping, required seismic and thermal expansion loops, and wiring. Identify proposed deviations from system as shown in Contract Documents.
- D. Engineering Data: Submit fan curves and sound power level data for each fan unit. Data shall be at the scheduled capacity. Data shall include the name of the rating agency or independent laboratory.

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1.05 INFORMATIONAL SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Roof Curb Data: For roof mounted equipment where combined weight of equipment unit and roof curb or rail exceeds 400 pounds, submit calculations from manufacturer for roof curbs proving compliance with the seismic requirements of the California Building Code, and ASCE 7-10. Manufacturer shall certify that roof curbs are suitable for use indicated on Drawings and in Specifications for the seismic design category indicated in structural Contract Documents. Calculations shall be stamped and signed by a State of California registered structural engineer.
- C. Economizer Fault Detection and Diagnostics (FDD) System Data: For all air-cooled unitary direct-expansion units equipped with an economizer, provide data for third-party supplied California Energy Commission certified FDD controller, documenting compliance with the requirements of California Building Energy Efficiency Standards. Provide evidence of certification.
- D. Record of pre-installation meeting.
- E. Training Certificates of Completion: Submit certificate from equipment manufacturer, indicating attendance and successful completion of manufacturer's training program for variable refrigerant flow systems installation and service. Training shall include manufacturer's preferred methods for assembling and insulating refrigerant piping and accessories.
- F. Coordinated Layouts: Submit coordinated layouts. For requirements refer to article, Coordinated Layouts, in this Section.

1.06 CLOSEOUT SUBMITTALS

- A. For additional requirements, refer to Section 23 00 50, Basic HVAC Materials and Methods.
- B. Maintenance Data: Submit maintenance data and parts list for each piece of equipment, control, and accessory; including "trouble-shooting guide," in Operation and Maintenance Manual.
- C. Record Drawings: Submit Record Drawings of installed ductwork, duct accessories, and outlets and inlets in accordance with requirements of Division 01.

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1.07 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. Belts: One set(s) for each belt-driven unit.
 - 2. Provide one complete set(s) of MERV-13 filters for each 4" filter bank.

1.08 COORDINATED LAYOUT

- A. Coordinated layouts are required to amplify, expand and coordinate the information contained in the Contract Documents.
- B. Provide minimum 1/4 inch equals one foot scaled coordinated layout drawings showing plan and pertinent section or elevation views of piping, ductwork, equipment, accessories, and electrical systems. Drawings shall be reproducible and work of each trade represented shall be fully coordinated with structure, other disciplines, and finished surfaces. Drawings shall be presented on a single size sheet. Coordinated layout drawings shall have title block, key plan, north arrow and sufficient grid lines to provide cross-reference to design Drawings.
 - 1. Provide a stamp or title block on each drawing with locations for signatures from all contractors involved, including but not limited to the General, HVAC, Plumbing, Fire Protection, and Electrical contractors. Include statement for signature that the contractor has reviewed the coordinated layout drawings in detail and has coordinated the work of his trade.
 - 2. Show on drawings the intended elevation of all ductwork in accordance with the following example:
 - a. B.O.D. = 9'-0"
 - 1) OFFSET UP 6"
 - 2) B.O.D. = 9'-6"
 - 3. Highlight, encircle or otherwise indicate deviations from the Contract Documents on the coordinated layouts. Architect will not be responsible for identifying deviations from the original Contract Documents.
- C. Since scale of contract drawings is small and all offsets and fittings are not shown, Contractor shall make allowances in bid for additional coordination

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time, detailing, fittings, offsets, hangers and the like to achieve a fully coordinated installation. If changes in duct size are required, equivalent area shall be maintained and the aspect ratio shall not be in excess of 2 to 1 unless approved by the engineer. Drawings shall be submitted for review prior to fabrication and installation. Drawings may be submitted in packages representing at least one quarter of the building ductwork.

- D. Check routing on all ductwork before fabricating. Report any discrepancies to Architect. No extra cost will be allowed for failure to conform to above.

1.09 QUALITY ASSURANCE

A. Design Criteria:

1. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
 2. Supply all equipment and accessories in accordance with requirements of applicable national, state and local codes.
 3. All items of a given type shall be products of the same manufacturer.
 4. Scheduled equipment performance is minimum capacity required.
 5. Scheduled electrical capacity shall be considered as maximum available.
- B. Pump types and sizes regulated by the US Department of Energy's "Energy Conservation Standards for Pumps" 10 CRF Parts 429 and 431 shall be marked with a compliant PEICL or PEIVL (Pump Energy Index, constant or variable load) value, basic model number, and RPM on the nameplate. Regulated pumps shall be listed in the Hydraulic Institute (HI) Energy Rating database (er.pumps.org) and be assigned an Energy Rating as defined in the HI 40.5 program guide.
- C. Variable Refrigerant Flow Split-System Heat Pump Installer Training: Installing contractor shall have completed training in installation and service of VRF system, by equipment manufacturer.
1. Installing contractor shall obtain, at his own cost, equipment manufacturer's VRF system service tool, unless service tool is normally resident on controller specified for this Project.

1.10 FIELD CONDITIONS

- A. Interruption of Existing Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then

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HEATING, VENTILATING AND AIR
CONDITIONING

LPCE Project #: 24-2001

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only after arranging to provide temporary services according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of services.
2. Do not interrupt services without Architect's written permission.

1.11 WARRANTY

- A. Air Conditioning Unit, Roof-Mounted:
 1. Compressor shall have a five-year warranty.
 2. Standard heat exchanger shall have a ten-year warranty.
- B. Heat Pump Unit, Roof-Mounted: Compressor shall have a five-year warranty.
- C. Heating and Ventilating Unit: Heat exchanger shall have minimum 10-year warranty.
- D. High Efficiency Furnace Unit:
 1. Heat exchangers shall have a 20-year warranty.
 2. Entire unit shall have a 5-year warranty.
- E. Air Cooled Condensing Unit: Unit shall have 5-year limited compressor warranty.

1.12 REFERENCE STANDARDS

- A. ANSI Z21.47 - American National Standard for Gas-Fired Central Furnaces; 2021.
- B. ASCE 7-10 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2010.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- D. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges; 2021.
- E. ASME B31.1 - Power Piping; 2022.
- F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.

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- G. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- H. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- J. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.
- K. ISO 9001 - Quality Management Systems — Requirements; 2015.
- L. MSS SP-67 - Butterfly Valves; 2022.
- M. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- N. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- O. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- P. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- Q. NFPA 17A - Standard for Wet Chemical Extinguishing Systems; 2013.
- R. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- S. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- T. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- U. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- V. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- W. UL 555C - Standard for Safety Ceiling Dampers; Current Edition, Including All Revisions.
- X. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

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- Y. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- Z. UL 1046 - Standard for Grease Filters for Exhaust Ducts; Current Edition, Including All Revisions.
- AA. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.
- BB. UL 2518 - Standard for Safety Air Dispersion Systems; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).

2.02 HEAT PUMP UNIT, ROOF-MOUNTED

- A. Provide factory assembled single packaged outdoor rooftop mounted, electrically controlled electric cooling and heating unit, rated in accordance with ARI Standards 210/240 or 340/360, and ETL or UL listed and labeled, classified in accordance with UL 1995. Provide refrigerant charge R-410A, all internal wiring, piping, controls, and special features required prior to field startup. Design unit to conform to the following:
 - 1. ASHRAE 15.
 - 2. ASHRAE 90.1.
 - 3. Insulation, adhesive, and all materials exposed to air stream shall meet NFPA 90A requirements for flame spread and smoke generation.
 - 4. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
- B. Unit shall be rated in accordance with ARI sound standards 270.
- C. Unit shall be ETL or UL tested and certified in accordance with ANSI Z21.47 Standards as a total package.
- D. Roof curb shall be designed to conform to NRCA Standards.

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- E. Unit shall be manufactured in a facility registered to ISO 9001:2000.
- F. Unit shall be Energy Star qualified.
- G. Cabinet:
 - 1. Provide galvanized steel unit cabinet, bonderized and coated with a baked enamel finish.
 - 2. All airstream interior surfaces shall be insulated with a minimum 1/2 inch thick, 1 lb density cleanable insulation. Heat compartment for optional electric heater shall be insulated with minimum 1/2 inch thick, 1 lb. density foil-faced insulation.
 - 3. Cabinet panels shall be removable. Provide access panels for the filter, compressors, evaporator fan, and control box. Each external hinged access panel shall be insulated, with insulation encapsulated with panel or with sealed edges.
 - 4. Return air filters shall be accessible through a dedicated tool-less removable access panel.
 - 5. Fork lift slots shall be provided in unit base rail. Base rail shall be minimum 16 gauge.
 - 6. Unit shall have a factory-installed internally sloped condensate drain pan, providing minimum 3/4 inch-14 NPT connections for both horizontal and alternate vertical drain configuration. See Drawings for drain configuration. Pan shall be removable for cleaning and maintenance. All drain pans shall conform to ASHRAE 62.1 self-draining provisions.
 - 7. Unit shall have standard side and alternate field or factory installed thru-the-bottom power and control wiring connection capability.
 - 8. Unit shall be field or factory convertible to horizontal air discharge.
- H. Fans:
 - 1. Centrifugal supply air blower (evaporator fan) shall have permanently lubricated bearings. Provide belt-driven double inlet fan wheel, centrifugal type with forward curved blades and adjustable sheaves. Fan wheel shall be steel, with corrosion resistant finish, dynamically balanced.
 - 2. Evaporator-fan motors shall be continuous operation, open drip-proof, and thermally protected. Bearings shall be sealed, permanently lubricated ball-bearing type.

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3. Condenser fans shall be of the direct-driven propeller type, with corrosion-resistant aluminum blades. Fans shall be dynamically balanced and discharge air upwards. Condenser-fan motors shall be totally enclosed and thermally protected.

I. Compressor:

1. Fully hermetic, scroll type with internal high-pressure and temperature protection. Furnish with crankcase heater when normally supplied as standard equipment for model size scheduled on Drawings.
2. Factory installed rubber shock mounted and internally spring mounted for vibration isolation.
3. Compressor Anti-Recycle Timer: Compressor shall be prevented from restarting for a minimum of five minutes after shutdown, with manufacturers installed compressor cycle delay.

J. Coils:

1. Standard evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless internally finned copper tubes with all joints brazed.
2. Condenser coils shall be single slab, single pass design. Single slab, 2 pass design may be utilized when supplied as standard equipment for unit size as scheduled on the Drawings.
3. Coils shall be leak tested at minimum 150 psig and pressure tested at minimum 450 psig.

K. Refrigerant Components:

1. Each refrigerant circuit shall include:
 - a. Fixed orifice metering device.
 - b. Solid core refrigerant filter driers with pressure ports.
 - c. Refrigerant pressure gage ports and connections on suction, and discharge lines.
 - d. Suction line accumulator.
 - e. Reversing valve.

L. Filter Section:

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1. Standard filter section shall accommodate 4 inch deep filters. Filters shall conform to the "Air Filters" Article in this Specification Section.
2. Filter section shall use standard size filters.

M. Controls:

1. Unit shall be complete with self-contained low voltage fuse protected control circuit. Refer to Section 25 50 00, if included, and equipment schedule, sequence of operation and control diagram on Drawings for additional requirements.
2. When third party direct digital controls with an Energy Management System will be utilized, provide electro-mechanical controls with 24V thermostat interface.
3. When stand-alone thermostat operation is utilized, provide electro-mechanical controls with 24V thermostat interface or provide microprocessor controls.
4. When stand-alone thermostat operation is utilized for single-zone VAV units, provide microprocessor controls. Units shall have factory mounted supply fan variable frequency drives.
5. When third party direct digital controls with an Energy Management System will be utilized for single zone VAV units, provide microprocessor controls with BACnet or LON interface. Units shall have factory mounted supply fan variable frequency drives.
6. Electro-mechanical controls shall include the following, as a minimum:
 - a. Provide compressor minimum off time (5 minutes).
 - b. Economizer control.
 - c. Time delay relay.
 - d. Integrated adjustable defrost cycle.
7. Microprocessor controls shall be ASHRAE 62.1 compliant and include the following, as a minimum:
 - a. User diagnostic interface.
 - b. Unit control with standard suction pressure transducers and condensing temperature thermistors.

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- c. Shall provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard.
- d. Service run test capability.
- e. Shall accept input from a CO2 sensor (indoor) and provide demand ventilation control.
- f. Provide compressor minimum off time (5 minutes).
- g. Service diagnostic mode.
- h. Economizer control.
- i. Time delay relay.
- j. Integrated adjustable defrost cycle.

N. Safeties:

- 1. Unit shall incorporate a solid-state compressor lockout that provides optional reset capability at the space thermostat, should any of the following safety devices trip and shut off compressor:
 - a. Compressor lockout protection provided for either internal or external overload.
 - b. Low-pressure protection.
 - c. Freeze protection (evaporator coil).
 - d. High-pressure protection (high pressure switch or internal).
 - e. Compressor reverse rotation protection.
 - f. Loss of charge protection.
 - g. Start assist on single-phase units.
- 2. Supply-air sensor shall be located in the unit and detect both heating and cooling operation.
- 3. Phase Protection: Provide unit-mounted "SymCom," or equal, Motor Saver three phase voltage monitor, model 201A or equal, adjustable voltage range for each unit, install per manufacturer's recommendations, mount in NEMA 3R enclosure if exposed to the weather.
 - a. Units shall provide the following features:

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- 1) Low voltage fault trip and reset.
- 2) Voltage unbalance/phasing fault trip and reset.
- 3) High voltage fault trip and reset.
- 4) Transient Protection (Internal).
- 5) Automatic restart.

b. Provide each unit with 600V socket, "SymCom" model OT08, or equal.

O. Operating Characteristics:

1. Unit shall be capable of starting and running at 115° F ambient outdoor temperature per maximum load criteria of ARI Standards 210/240 or 340/360.
2. Unit with microprocessor or electro-mechanical controls shall operate in cooling down to an outdoor ambient temperature of 25° F.
3. Unit shall be provided with fan time delay to prevent cold air delivery in heating mode.

P. Electrical Requirements:

1. All unit power wiring shall enter unit cabinet at a single location. Both unit side and bottom power entry provisions shall be provided. Refer to Drawings schedule for thru-the-bottom power wiring requirement.

Q. Motors:

1. Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have line break thermal and current overload protection.
2. Evaporator fan motor shall have permanently lubricated, sealed bearings and inherent automatic-reset thermal overload protection or manual reset calibrated circuit breakers.
3. Totally enclosed condenser-fan motor shall have permanently lubricated, sealed bearings, and inherent automatic-reset thermal overload protection.
4. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.

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- R. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. Carrier Corporation.
 2. York – Johnson Controls
 3. Lennox
 4. AAON
- S. Provide the following additional features and equipment:
1. Roof Curb: formed galvanized steel with wood nailer strip capable of supporting entire unit weight. Provide 3 inch wide bottom flange.
 2. Provide heavy-duty 18 gauge expanded metal coil guard grille to protect all surfaces of the condensing coil. Coil guard to be Micrometl, Canfab, or equal.
 3. Modulating Power Exhaust Economizer: Micrometl, Canfab, or equal. Integrated type capable of simultaneous economizer and compressor operation.
 - a. Provide self-contained outdoor rooftop system, mounted directly to the return air compartment of the HVAC packaged equipment. Provide differential dry bulb economizer control system and a factory programmed, fully programmable variable frequency drive package controlled by a differential pressure transmitter, mounted directly to the return air compartment of the HVAC packaged equipment. Design the system to continuously maintain space pressure, and provide capability of introducing up to 100 percent outdoor air.
 - 1) Economizer control system shall be certified as meeting the requirements for Fault Detection and Diagnostics (FDD) in the California Building Energy and Efficiency Standards.
 - b. Provide outside differential pressure tubing termination with hex style pneumatic filter-muffler, minimum filtration 40 microns, 53 SCFM maximum at 100 psi, as manufactured by McMaster-Carr, or equal.
 - c. Provide hinged cabinet access doors and include latches to provide a tool-less entry for servicing.

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- d. Provide door lock on the power exhaust cabinet to meet ETL safety requirements.
- e. Outdoor air intake dampers shall be low leak not to exceed 3 percent at 1 inch wg pressure differential and include stainless steel side seal and neoprene edge seal. Arrange dampers to close upon loss of power.
- f. Provide belt driven exhaust blowers, double inlet, forward-curved centrifugal type. Provide gravity backdraft damper at fan outlet.
- g. Provide fully programmable factory programmed variable frequency drive (VFD) package for each fan, driven by 4 to 20 mA signal from a differential pressure transmitter. Pressure transmitters shall measure 0 - 0.1 in wg. Install room sensor tubing with sensor tube termination installed within the room.
 - 1) Where direct digital controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls required to make the system fully operational.
 - 2) Where stand-alone controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls, including logic module, required to make the system fully operational.
- T. Replenish for a period of one year without cost to the Owner all refrigerant and oil required to maintain the proper levels.
- U. Owner Training: Manufacturer shall provide two initial on-site 4-hour training sessions for Owners' maintenance personnel. Manufacturer shall provide one 4-hour follow-up training session to be scheduled by Owner within one year of the date of the final initial training session. Training session agenda shall be as follows:
 - 1. First session: Equipment.
 - 2. Second session: Controls.
 - 3. Follow-up session: Agenda by Owner.

2.03 FANS

- A. All fans shall be Air Moving and Control Association Inc. (AMCA) labeled.

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- B. Provide self-aligning, enclosed ball bearings, accessible for lubrication unless specified otherwise.
- C. Provide variable speed switch for all direct drive fans.
- D. Roof Mounted:
 - 1. Direct or V-belt Drive: Provide one-piece heavy-duty ventilator housings, one piece heavy gauge spun aluminum construction, with weatherproof assembly and integral weather shield. Mount ventilators on curbs furnished by the fan manufacturer. Install with fan assembly level.
 - 2. Fan wheels shall be centrifugal design, statically and dynamically balanced. Tip speed, rpm and motor horsepower shall not exceed listing in manufacturer's catalog for unit specified.
 - 3. Fans shall have integral factory formed base and one piece spinning without welding. Housings shall be provided with wiring channel and are to be of the direct discharge design. Motor and fan assembly shall be on vibration isolating mounts. Fans shall have capacity, speeds and motor sizes as shown.
 - 4. Provide the following accessories:
 - a. Gravity backdraft dampers.
 - b. Aluminum bird screen with a minimum of 85 percent free area.
 - c. Adjustable motor pulley.
 - d. Laboratory fume hood exhaust fans shall be Keysite coated.
 - e. Provide grease collection tray for kitchen exhaust fans.
 - f. Provide ventilated roof curb for kitchen exhaust fans where exhaust duct is mounted within rated shaft.
 - g. Provide hinge kit for kitchen hood exhaust fans.
- E. Fan Drives:
 - 1. Drive Design: The design horsepower rating of each drive shall be at least 1.5 times, single belt drives 2 times, the nameplate rating of the motor with proper allowances for sheave diameters, speed ratio, arcs of contact and belt length.

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2. Provide variable speed drives, Dayco, Browning, Woods, or equal. Allow for replacement of fan and motor drives and belts as required to suit the balance requirements of the project.
3. Select variable speed drives to allow an increase or decrease of minimum of ten percent of design fan speed.

F. Motors:

1. Motors of 25 HP and less shall have adjustable pitch sheaves; sheaves on motors above 25 HP may be non-adjustable. Change, at no extra cost to Owner, the non-adjustable sheaves to obtain desired air quantities.
2. For single-phase fan motors sized larger than 1/12 hp and smaller than 1 hp, refer to Article, Electric Motors, in Section 23 00 50, Basic HVAC Materials and Methods.

G. Sheaves: Sheaves shall be cast or fabricated, bored to size or bushed with fully split tapered bushings to fit properly on the shafts. All sheaves shall be secured with keys and set screws.

H. Belts:

1. All belts shall be furnished in matched sets.
2. Belts shall be within 1 degree 30 minutes of true alignment in all cases.

I. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.

J. Owner Training: Manufacturer shall provide one on-site 1-hour training session for Owners' maintenance personnel.

2.04 KITCHEN EXHAUST HOOD – TYPE 1

A. Furnish packaged pre-manufactured ventilator, constructed of stainless steel, complete with baffles and lights. Unit shall be equal to that specified in equipment schedule.

B. Each ventilator shall be a high velocity type grease extractor.

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1. Centrifugal grease extraction efficiency of 90 percent to be accomplished without the use of filters, cartridges, or constant running water. (Verify with hood selected)
- C. Compensating ventilators shall not be of the short-circuiting type. Furnish integral front face discharge for up to 80 percent make-up air of the exhausted air.
- D. Construction: The ventilator shall be of all stainless steel construction not less than 18 gauge, Type 304, number 4 finish. The assembly at joints and seams shall be liquid tight and all exposed external welds shall be ground and polished to match the original finish of the metal. All unexposed surfaces shall be constructed of minimum 18 gauge galvanized steel, including but not limited to duct, plenums, framing and brackets. Provide stainless steel closure panels as required for a complete finish, satisfactory to the Architect.
- E. Filters: Grease Filters shall be manufactured in accordance with UL 1046.
- F. Approvals: Ventilators to be listed or recognized by ICBO (refer to Research Report 2064), NSF, UL and in accordance with all recommendations of NFPA's Standard #96.
- G. Fire Suppression System:
1. Fire suppression system shall be listed and labeled as conforming to NFPA 17A and UL 300, current edition.
 2. Furnish wet chemical system to protect the hood, exhaust duct and cooking appliances against fire. The system shall be installed by an authorized distributor in accordance with NFPA 96, NFPA 17A, UL listings, and the requirements of authorities having jurisdiction.
 3. The system shall be manually operable at the release. The system shall contain a fusible link series detector system for automatic actuation of the system. Actuation of the system shall provide automatic mechanical gas valve line shutoff. Provide manual operation, with local actuation at the tank enclosure.
 4. System shall consist of suppressant, pressurizing cartridge, Schedule 40 piping and nozzles. Provide system with fresh cartridge. Provide stainless steel enclosure for cartridge, regulated release mechanism, regulator and all other material required for operation of the system.
 5. System shall be Ansul R102, Kidde, or equal. Provide multiple system if required.

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6. Upon completion of the installation of the fire suppression system a test of the system shall be conducted in the presence of the enforcing agency.
- H. Owner Training: Manufacturer shall provide one on-site 1-hour training session for Owners' maintenance personnel.

2.05 AIR INLETS AND OUTLETS

- A. Except as otherwise indicated, provide manufacturer's standard inlets and outlets where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Ceiling, wall or floor Compatibility: Provide inlets and outlets with border styles that are compatible with adjacent ceiling, wall or floor systems, and that are specifically manufactured to fit into ceiling, wall or floor module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems that will contain each type of air outlet and inlet.
- C. Refer to Schedule on Mechanical Drawings for details of inlets and outlets to be used.

2.06 AIR FILTERS

- A. Provide MERV 13 disposable pleated media type. Refer to specific equipment Articles for filter depth and for exceptions to this specification. Filters shall conform to the following:
 1. Standards:
 - a. ASHRAE Standard 52.2-2007.
 - b. Underwriters Laboratories: U.L. 900, Class 2.
 2. Construction:
 - a. Media: Synthetic or cotton-synthetic blend with radial pleats.
 - b. Media Frame: High wet-strength beverage board.
 - c. Media Support: Welded wire or expanded metal grid bonded to air leaving side of the media.
 3. Performance: 4" deep filter shall have a maximum initial air resistance of 0.31 inches w.g.

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- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
1. Camfil Farr, Inc., model 30/30.
 2. Flanders Corporation, model 40 LPD.
- C. Temporary (Construction Period) Filters:
1. Install new temporary filters in all units that have filter systems installed. Temporary filters shall match the permanent filters that are specified for the units. Replace filters as needed, in accordance with manufacturer's directions, in order to provide protection for the unit prior to occupancy by the Owner.
 2. If air handling units are operated during construction of the project, install temporary filters directly over each return air inlet. Filters shall match the permanent filters that are specified for the units. Select size of filter to completely cover the frame of the return air inlet, and tape filters firmly in place to eliminate any construction debris from entering the duct system or unit. Remove the temporary filters upon completion of the work, and repair all damaged paintwork.
- D. Spare Filters:
1. Furnish two new, complete sets of filter cartridges for each filter bank on completion and acceptance of the work. Install one set of filters in units (prior to final air balance). Provide units designed to accommodate washable, permanent filters with one washable, permanent filter.

2.07 DAMPERS

- A. Backdraft Dampers: Ruskin CBD2, counterbalanced, Nailer Industries, or equal.
- B. Manual Air and Balance Dampers: Provide dampers of single blade type or multi-blade type constructed in accordance with SMACNA, "HVAC Duct Construction Standards," except as noted herein.
1. Rectangular Ductwork:
 - a. Single damper blades may be used in ducts up to 10 inches in height. Dampers shall be 16 gauge minimum. Provide self-locking regulators,

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equal to Ventlok 641. Provide end bearings equal to Ventlok 607 at each damper. Provide continuous solid 3/8 inch square shafts.

- b. Multiple blade dampers shall be equal to Ruskin CD35 Standard Control Damper. Maximum width for multiple damper blades for use in rectangular duct shall not exceed 6 inches.
- c. Where duct velocity may be expected to exceed 1500 fpm, provide Ruskin CD-50, or equal, low leakage dampers with airfoil blades.

2. Round Ductwork:

- a. Single damper blades may be used in ducts up to 12 inches in diameter. Provide multiple blade opposed blade dampers, with connected linkage, for ductwork larger than 12 inches in diameter.
- b. Damper blades for round ductwork shall be 20 gauge steel for ducts up to 12 inches diameter and 16 gauge steel for dampers larger than 12 inches damper. Provide self-locking regulators, equal to Ventlok 641, Durodyne, or equal for operation of dampers. Provide end bearings equal to Ventlok 607 and provide continuous solid 3/8 inch square shafts.

- 3. Where ductwork is externally insulated, provide self-locking regulators equal to Ventlok 644, Durodyne, or equal for rectangular ductwork, and Ventlok 637, Durodyne, or equal for round ducts.

- C. Where required to suit the size of damper required, provide manufacturers standard UL Classified mullions, arranged to support multiple dampers. Assembly shall be of minimum 16 gauge galvanized steel, complete with all accessory caps and framing members required for installation.

2.08 DUCTWORK

- A. Construct and install sheet metal ductwork in accordance with the California Mechanical Code for 2 inches static pressure for supply air, and 2 inches minimum for return and exhaust air unless otherwise noted on Drawings.
 - 1. Where not in conflict with the California Mechanical Code, construct and install all sheet metal ductwork in accordance with SMACNA HVAC Duct Construction Standards (Metal and Flexible). Where applicable for HVAC work, construct and install sheet metal work in accordance with SMACNA Architectural Sheet Metal Manual.

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2. Provide variations in duct size, and additional duct fittings as required to clear obstructions and maintain clearances as approved by the Architect at no extra cost to the Owner.
 3. Gauges, joints and bracing shall be in accordance with the California Mechanical Code.
 4. Provide beading or cross breaking for all ductwork inside building. Provide cross breaking for ductwork exposed to weather.
 5. At the contractor's option, ductwork may be fabricated using the Ductmate, Nexus, Quickduct, Transverse Duct Connection (TDC), Pyramid-Loc duct connection systems, or equal. Fabricate in strict conformance with manufacturer's written installation instructions and in accordance with California Mechanical Code.
 - a. Seal flanged ends with pressure sensitive high density, closed cell neoprene or polyethylene tape gasket, Thermo 440, or equal.
 - b. Provide metal clips for duct connections, except at breakaway connections for fire dampers and fire smoke dampers. Provide corner clips at each corner of duct, through bolted, at all locations except at breakaway connections for fire dampers and fire smoke dampers. Where used on locations exposed to weather, provide continuous metal clip at top and sides of duct, with 1 inch overhang for top side.
- B. Design and installation standards:
1. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) for all work in this section.
 2. NFPA Compliance: Comply with ANSI/NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," and ANSI/NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."
 3. California Mechanical Code.
- C. Duct sizes indicated are external sizes.
- D. Galvanized Sheet Steel: Lock-forming quality, ASTM A924 and ASTM A653, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.

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1. Provide mill certification for galvanized material at request of the Project Inspector.

E. Duct Sealants:

1. Sealant shall have a VOC content of 250 g/L or less.
2. [Sealant shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.
3. Provide one part, non-sag, synthetic latex sealant, formulated with a minimum of 68 percent solids. Sealant shall comply with ASTM E84, Surface Burning Characteristics.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Design Polymerics, model DP1010.
 - 2) Polymer Adhesive Sealant Systems Inc, model Airseal #11.
 - 3) McGill Airseal, LLC.

F. Duct Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, straps, trim, and angles for support of ductwork.

G. Rectangular Duct Fabrication:

1. Shop fabricate ductwork of gauges and reinforcement complying with the more stringent of the following standards, except as noted herein.
 - a. SMACNA HVAC Duct Construction Standards
 - b. California Mechanical Code
2. Fabricate ducts for 2 inch pressure class with minimum duct gauges and reinforcement as follows, except as otherwise noted:

Table A		
Duct Dimension	Minimum Gauge	Joint Reinforcement Per CMC
Through 12"	26	Not Required
13" through 18"	24	Not Required

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19" through 30"	24	C/4
31" through 42"	22	E/4
43" through 54"	22	F/2
55" through 60"	20	G/4
61" through 84"	20	I/2
85" through 96"	20	J/2
Over 96"	18	K/2

3. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width. Fabricate to include single thickness turning vane in elbows where space does not permit the above radius or where square elbows are shown. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers. Turning vanes shall be E-Z Rail II, Durodyne, or equal.
4. Fabricate round supply connections at rectangular, plenum type fittings using spin-in type fittings, complete with extractor and volume control damper. Refer to Paragraph "DAMPERS" for damper requirements.
5. Provide drive slip or equivalent flat seams for ducts exposed in the conditioned space or where necessary due to space limitations. On ducts with flat seams, provide standard reinforcing on inside of duct. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.
6. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
7. Provide 20 gauge minimum for ductwork exposed within occupied spaces.

H. Rectangular Internally Insulated Duct Fabrication:

1. Provide internal duct lining where indicated on the Drawings, with a minimum of 10'-0" length in each direction from the fan, fan casing, or unit casing. Line all transfer ducts.
 - a. Where ductwork is exposed to weather or outside the building insulation envelope, provide 2 inch thick, 1-1/2 pound density internal lining with matte facing, with an R-Value of 8.0 minimum.

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- b. Where ductwork is within the building insulation envelope, lining shall be 1" thick, 1-1/2 pound density, with R-value of 4.2 minimum.
- c. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
- d. Where installed exposed in the conditioned space, duct shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value – R-4.2).
- e. Cement duct liner in place with nonflammable, non-hardening duct adhesive. Seal all raw edges of insulation inside ductwork with adhesive, including longitudinal liner edges.
- f. Provide metal nosing at all locations where liner is preceded by unlined metal.
- g. Provide sheet metal weld pins and washers or clinch pins and washers on all ductwork on 12 inch intervals with the first row within 3 inches of the leading edge of each piece of insulation and within 4 inches of corners. No use of adhesive mounted pins will be considered.
 - 1) Install clinched pin fasteners with properly adjusted automatic fastening equipment. Manual installation will not be considered.
 - 2) Install weld pins with properly adjusted automatic fastening equipment. Installation shall not damage the galvanized coating on the outside of the duct.
- h. All ductwork, adhesives, lining, sealant, flex duct and the like shall have a flame spread of 25 or less and developed smoke rating of 50 or less when tested in accordance with one of the following test methods: NFPA 255, ASTM E84, or UL 723.
- i. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

Manufacturer:	Product:
Johns Manville	Linacoustic RC
CertainTeed Corporation	ToughGard
Fosters Adhesive	85-62

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Swifts Adhesive	7336
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I. Round and Oval Ductwork Fabrication:

1. Round and oval duct and fittings shall be spiral lockseam or longitudinal seam as indicated in table below. Provide couplings to join each length of duct.
 - a. At contractors' option, round or oval ductwork may be utilized in place of rectangular ductwork shown on Drawings, provided available space allows installation of round or oval ductwork without compromising space required for installation of products and systems of other trades.
 - 1) Round or oval ductwork utilized in place of rectangular ductwork shown on Drawings shall be sized to have a static pressure loss equivalent to rectangular duct shown on Drawings.
 - 2) Unlined round or oval duct shall not be utilized in place of rectangular internally lined ductwork shown on Drawings.
2. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width. Provide two-piece, die-stamped, 45-degree to 90-degree elbows for sizes up to 12 inches; five-piece, 90-degree elbows for sizes 12 inches and above; conical tees; and conical laterals. All reducers shall be placed after a tap has been made on the duct main. Reducers shall be long-taper style.
3. Round Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 653 by the following methods and in minimum gauges listed.

Diameter	Minimum Gauge	Method of Manufacture
Up to 14"	26	Spiral Lockseam
15" to 23"	24	Spiral Lockseam
24" to 36"	22	Spiral Lockseam
37" to 50"	20	Spiral Lockseam
51" to 60"	18	Spiral Lockseam
Over 60"	14	Longitudinal Seam

4. Provide locked seams for spiral duct; fusion welded butt seam for longitudinal seam duct.

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5. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seams at exposed ducts. Provide spot weld bonded seams at concealed ducts.

Diameter	Minimum Gauge
3" to 36"	20
38" to 50"	18
Over 50"	16

6. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
7. Provide 20 gauge minimum for ductwork exposed within occupied spaces.

- J. Round Internally Insulated Duct and Fittings: Where ductwork is exposed to weather or outside the building insulation envelope, construct with outer pressure shell, 2 inch thick (Minimum R-value = R-8) insulation layer, and perforated inner liner. Where ductwork is within the building insulation envelope, construct with outer pressure shell, 1 inch thick (minimum R-value = R4.2) insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ANSI/ASTM A 653, of spiral lockseam construction (use longitudinal seam for over 59 inches), in minimum gauges listed in table below. Where installed exposed in the conditioned space: duct and fitting outer pressure shell shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value = R-4.2), and perforated inner liner.

Nominal Duct Diameter	Outer Shell	Inner Liner
3" TO 12"	26 gauge	24 gauge
13" TO 24"	24 gauge	24 gauge
25" to 34"	22 gauge	24 gauge
35" to 48"	20 gauge	24 gauge
49" to 58"	18 gauge	24 gauge
Over 59"	16 gauge	20 gauge

1. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams of outer shell at exposed ducts. Provide spot weld bonded seams at concealed ducts.

Nominal Duct Diameter	Outer Shell	Inner Liner
3" to 34"	20 gauge	24 gauge
36" to 48"	18 gauge	24 gauge
Over 48"	16 gauge	24 gauge

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2. Inner Liner: Perforate with 3/32 inch holes for 22 percent open area. Provide metal spacers welded in position to maintain spacing and concentricity.
3. Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.
4. Where installed exposed in the conditioned space, duct shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value – R-4.2).
5. All ductwork, adhesives, lining, sealant, flex duct and the like shall have a flame spread of 25 or less and developed smoke rating of 50 or less when tested in accordance with one of the following test methods: NFPA 255, ASTM E84, or UL 723.
6. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Sheet Metal Div., McGill AirFlow, LLC., Acousti-k27
 - b. Semco Duct and Acoustical Products, Inc.
 - c. Air Systems Manufacturing, Inc. - Las Vegas

K. Duct Access Doors:

1. Duct Access: Provide hinged access door in rectangular ducts for access to fire dampers, control equipment, etc. Access door size shall be duct diameter wide by duct diameter high for all ducts under 24 inches. Ducts over 24 inches in diameter shall have 24-inch by 18-inch access doors. Minimum size access doors shall be 6 inches by 6 inches.
2. Provide hinged style access doors for round ductwork, NCA Manufacturing, Inc., Model AD-RD-87, Pottorff Series 60, or equal. Access doors shall be 16 gauge galvanized steel with continuous piano hinge. Locks shall be plated steel strike and catch. Provide 1" x 3/8" Polyethylene "Perma Stik" gasket all around door.

L. Flexible Air Ducts:

1. Provide exterior reinforced laminated vapor barrier, fiberglass insulation, encapsulated spring steel wire Helix, and impervious, smooth,

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non-perforated interior vinyl liner. Individual lengths of flexible ducts shall contain factory fabricated steel connection collars.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

- 1) C.A. Schroeder, Inc., Cal Flex model 2PMJ.
- 2) ThermaFlex model M KC.

2. Factory made air ducts shall be approved for the use intended and shall conform to the requirements of UL 181 and NFPA 90A. Each portion of a factory-made air duct system shall be identified by the manufacturer with a label or other suitable identification indicating compliance with UL 181, Class 1. Ducts shall be UL listed Class 1, maximum 25/50 smoke and flame spread and shall be installed in accordance with the terms of their listing and the requirements of SMACNA HVAC Duct Construction Standards (Metal and Flexible). Factory-made air ducts shall have the following minimum R-values: R-6.0 for ductwork installed within the building insulation envelope, R-8.0 for ductwork installed outside the building insulation envelope.
3. Flexible ductwork shall be maximum of 5 feet long, and shall be extended to the fullest possible length, in order to minimize pressure drop in the duct.
4. Flexible ducts shall be selected for minimum of 6 inch positive static pressure and minimum of 1 inch negative static pressure.

M. Kitchen Exhaust Ducts (Type 1):

1. Fabricate kitchen exhaust ducts and supports used for removal of smoke and grease-laden air from cooking equipment of 16 gauge minimum black steel where concealed and of 18 gauge minimum Type 304 stainless steel where exposed. At Contractor's option, 18 gauge minimum Type 304 stainless steel may be used where concealed. Finish exposed stainless steel with Number 4 finish. All ductwork shall be of welded construction in accordance with Section 510 of California Mechanical Code. For duct construction, comply with SMACNA "HVAC Duct Construction Standards" and ANSI/NFPA 96 "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations."
2. Kitchen Exhaust Duct Access Panels:

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- a. Provide listed duct access panel assembly of the same material and gauge used for the duct. Duct access panels shall conform to the following:
 - 1) Fasteners: Black steel or stainless steel to match material used for the duct. Panel fasteners shall not penetrate duct wall.
 - 2) Gasket: Comply with NFPA 96, grease-tight, high temperature ceramic fiber, rated for minimum 1500 °F.
 - 3) Minimum Pressure rating: 10 inches wg., positive or negative.
 - b. Available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Ductmate Industries, Inc.
 - 2) 3M.
 - 3) Flame Gard, Inc.
3. Field-Applied Grease Duct Enclosure:
- a. Thermal Ceramics Firemaster FastWrap XL, or equal, field-applied grease duct enclosure listed in accordance with ASTM E 2336.
- N. Type 1 Clothes Dryer Exhaust Ducts: Provide aluminum duct and fittings in wall and ceiling as indicated on Drawings.
- O. Type 2 Clothes Dryer Exhaust Ducts:
- 1. Fabricate ducts and supports of 18 gauge minimum, Type 304, stainless steel. All duct seams and joints shall be welded. Finish exposed stainless steel with Number 4 finish.
- P. Flexible Connectors:
- 1. Materials: Flame-retardant or noncombustible fabrics. Coatings and adhesives shall comply with UL 181, Class 1, with flame spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Metal-Edged Connectors: Factory fabricated with a fabric strip 3 inches wide attached to two strips of 3-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

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3. Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - a. Minimum Weight: 26 oz./sq. yd.
 - b. Tensile Strength: Minimum 475 lbf/inch in the warp and minimum 375 lbf/inch in the filling.
 - c. Service Temperature: Minus 50 to plus 200 deg F.
4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Ductmate Industries, Inc., model Proflex.
 - b. Ventfabrics, Inc., model Ventlon.

2.09 INSULATION MATERIALS

A. General:

1. Insulation products, including insulation, insulation facings, jackets, adhesives, sealants and coatings shall not contain polybrominated diphenyl ethers (PBDEs) in penta, octa, or deca formulations in amounts greater than 0.1 percent (by mass).
2. Products shall not contain asbestos, lead, mercury, or mercury compounds.
3. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
4. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
5. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
6. Test insulation, jackets and lap-seal adhesives as a composite product and confirm flame spread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with UL723 or ASTM E84.

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7. Adhesives and sealants shall comply with testing and product requirements of South Coast Air Quality Management District, Rule 1168.

B. Insulation Materials:

1. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Aeroflex USA, Inc.
 - 2) Armacell LLC.
 - 3) K-Flex USA.
2. Mineral-Fiber, Preformed Pipe Insulation:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Johns Manville; a Berkshire Hathaway company.
 - 2) Knauf Insulation.
 - 3) Manson Insulation Inc.
 - 4) Owens Corning.
 - b. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL.
3. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Provide 2-inch wide stapling and taping flange.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) CertainTeed Corporation.

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- 2) Johns Manville.
 - 3) Knauf Insulation.
 - 4) Owens Corning.
4. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) CertainTeed Corporation.
 - 2) Johns Manville.
 - 3) Knauf Insulation.
 - 4) Owens Corning.
5. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) CertainTeed Corporation.
 - 2) Johns Manville; a Berkshire Hathaway company.
 - 3) Knauf Insulation.
 - 4) Owens Corning.
- C. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

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1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Design Polymerics.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 3. Service Temperature Range: 0 to plus 180 deg F.
 4. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Design Polymerics.
 - b. Childers Brand; H. B. Fuller Construction Products.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - a. Design Polymerics.
 - b. Childers Brand; H. B. Fuller Construction Products.
 - c. Foster Brand; H. B. Fuller Construction Products.

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- d. Knauf Insulation.
- 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
- 3. Service Temperature Range: 0 to plus 180 deg F.
- 4. Color: White.
- F. Field Applied Jackets:
 - 1. PVC Jacket and Factory Fabricated Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Johns Manville, model Zeston, with Zeston 2000 fitting covers.
 - 2) Proto Corporation, model LoSmoke.
 - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:
 - 1) Childers Brand; H. B. Fuller Construction Products.
 - 2) ITW Insulation Systems; Illinois Tool Works, Inc.
 - 3) RPR Products, Inc.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 2) Tee covers.

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- 3) Flange and union covers.
- 4) End caps.
- 5) Beveled collars.
- 6) Valve covers.
- 7) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 TEMPERATURE CONTROL SYSTEM

- A. Refer to Section 23 09 23, Direct Digital Control System for HVAC.

PART 3 EXECUTION

3.01 ROOF MOUNTED EQUIPMENT INSTALLATION

- A. Mount and anchor equipment in strict compliance with Drawings details. Alternate anchorage methods will not be considered for roof mounted equipment.
- B. Examine rough-in for roof mounted equipment to verify actual locations of piping and duct connections prior to final equipment installation.
- C. Verify that piping to be installed adjacent to roof mounted equipment allows service and maintenance.
- D. Install ducts to termination at top of roof curb and install heavy duty rubber gaskets on supply and return openings and on full perimeter of curb, or as required for an airtight installation, prior to setting unit on curb.
- E. Cover roof inside each roof mounted air conditioning unit, heat pump unit, and heating and ventilating unit roof curb with 2 inch thick, 3 pound density fiberglass insulation board.
- F. Connect supply and return air ducts to horizontal discharge roof mounted equipment with flexible duct connectors. Provide G 90 galvanized steel weather hood over flexible connections exposed to the weather. Weather hood minimum gauge shall be per PART 2 article, Ductwork, Table A.
- G. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.

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3.02 FAN INSTALLATION

- A. Ceiling Mounted Fans: Mount variable speed switch within fan housing. Mark final balance point on variable speed switch.
- B. Provide access doors for fans or motors mounted in ductwork.
- C. Mount all fans as detailed on Drawings and in compliance with CBC standards.
- D. Fan motors mounted in air-stream to be totally enclosed.
- E. Completely line supply, return or exhaust fan cabinets with 1 inch thick, 3/4 pound density acoustic insulation securely cemented in place.
- F. Roof fans shall be mounted level.
- G. Provide heavy-duty rubber gasket between exhaust fan mounting flange and roof curb, or as required for an airtight installation.
- H. Label fume hood fans with sign "CAUTION - HAZARDOUS EXHAUST."

3.03 AIR INLETS AND OUTLETS INSTALLATION

- A. Provide all air inlets and outlets with gaskets and install so that there will be no streaking of the walls or ceilings due to leakage. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.
- B. Unless otherwise indicated on Drawings, provide rectangular galvanized steel plenum on top of each diffuser and ceiling return for connection to ductwork. Line plenum with internal insulation as indicated for lined ductwork. Size plenum to allow full opening into air terminal. Plenum sheet metal gauge shall be equal to gauge for rectangular equivalent of the branch duct serving the air inlet or outlet.
- C. Ceiling-mounted air inlets, outlets, or other services installed in T-Bar type ceiling systems shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
 - 1. Air inlets, outlets, or other services weighing not more than 56 pounds shall have two No. 12 gauge hangers connected from the terminal or service to the structure above. These wires may be slack.
 - 2. Support air inlets, outlets, or other services weighing more than 56 pounds directly from the structure above by approved hangers. Provide 4 taut 12 gauge wires each, attached to the fixture and to the structure above. The 4

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taut 12 gauge wires, including their attachment to the structure above must be capable of supporting 4 times the weight of the unit.

3. Secure air inlets and outlets to main runners of ceiling suspension system with two No. 8 sheet metal screws at opposing corners.
- D. Furnish all air inlets and outlets with a baked prime coat unless otherwise noted. Provide off-white baked enamel finish on ceiling-mounted air inlets and outlets. Paint exposed mounting screws to match the material being secured.
- E. Air inlets and outlets shall match all qualities of these specified including appearance, throw, noise level, adjustability, etc.

3.04 FILTER HOUSING INSTALLATION

- A. Mount filters in airtight galvanized steel housings furnished by the filter manufacturer, or shop fabricated. Housings shall incorporate integral tracks to accommodate filters, and flanges for connection to duct or casing system.
 1. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames and to prevent bypass of unfiltered air.
 2. Access Doors: Hinged, with continuous gaskets on perimeter and positive-locking latch handle devices.
- B. Air filters shall be accessible for cleaning or replacement.
- C. Identify each filter access door with 1/2 inch high minimum stenciled letters.

3.05 TEMPORARY FILTERS

- A. Provide temporary filters for fans that are operated during construction; after construction dirt has been removed from the building install new filters at no additional cost to the Owner. In addition to temporary filters at filter location, provide temporary filters on all duct openings which will operate under a negative pressure.
 1. Filters used for temporary operation shall be the same as permanent filters for the application. Filters used for duct openings may be 1 inch thick pleated media disposable type.

3.06 DAMPER INSTALLATION

- A. All dampers automatically controlled by damper motors are specified under "Temperature Control System" except those specified with items of equipment.

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- B. Provide opposed blade manual air dampers at each branch duct connection and at locations indicated on the drawings and where necessary to control air flow for balancing system. Provide an opposed blade balancing damper in each zone supply duct. Provide an access panel or Ventlok flush type damper regulator on ceiling or wall for each concealed damper.
- C. Install fusible link fire dampers full size of duct at points where shown or required.
- D. Provide 18 inch x 12 inch minimum hinged access doors in ductwork and furring for easy access to each fire damper; insulated access doors in insulated ducts. Label access doors with 1/2 inch high red letters.
 - 1. Provide Ventlok Series 100, Durodyne, or equal access doors with hardware for convenient access to all automatic dampers and other components of the system, insulated type in insulated ducts. Provide Ventlok #202 for light duty up to 2 inch thick doors, #260 heavy-duty up to 2 inch thick doors and #310 heavy-duty for greater than 2 inch thick doors. Provide #260 hinges on all hinged and personnel access doors; include gasketing.

3.07 DUCTWORK INSTALLATION

A. General:

- 1. Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true to shape and to prevent buckling. Where possible, install ductwork to clear construction by 1/4 inch minimum, except at air inlets and outlets. Where ductwork will not clear construction, secure duct firmly to eliminate noise in the system.
- 2. Duct Joints: Install duct sealers, pop rivets or sheet metal screws at each fitting and joint. Duct sealers shall be fire retardant. Sheet metal screws for joints shall be minimum #10 size galvanized.
- 3. Where ductwork is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.

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4. Horizontal runs of ductwork suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.
5. Provide sheet metal angle frame at all duct penetrations to wall, floor, roof, or ceiling.
6. Paint inside of ducts, visible through grille, dull black.
7. Where ductwork is installed in finished areas of buildings that do not have ceilings, paint ductwork, support hangers, and air inlets and outlets to match adjacent architectural surfaces, or as directed by Architect.
8. At the time of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, duct and other related air distribution component openings shall be covered with tape, plastic, sheet metal, or other methods acceptable to the enforcing agency.

B. Firestopping:

1. Pack the annular space between duct openings and ducts penetrating floors and walls with UL listed fire stop, and sealed at the ends. All pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.
 - a. Install fire caulking behind mechanical services installed within fire rated walls, to maintain continuous rating of wall construction.
2. Firestopping systems to be installed in strict accordance with manufacturer's instructions.
3. Alternate firestopping systems are acceptable if approved equal. However, any deviation from the above specification requires the Contractor to be responsible for determining the suitability of the proposed products and their intended use, and the Contractor shall assume all risks and liabilities whatsoever in connection therewith.

C. Flashing:

1. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.
2. Refer to Division 07 specifications and Drawings details as applicable.
3. Flashing for penetrations of roof for mechanical items such as flues and ducts shall be coordinated with the roofing manufacturer and roofing installer for the specific roofing type. The work of this section shall include

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furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.

- a. Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.
- b. Flues and ducts shall have 24 gauge galvanized sheet metal storm collar securely clamped to the flue above the flashing.

D. Upper connection of support to wood structure shall be with wood screws or lag screws in shear fastened in the upper one half of the wood structural member. Fasteners shall conform to the following schedule:

For ducts with P/2=30"	#10 x 1-1/2" wood screw
For ducts with P/2=72"	1/4"x 1-1/2" lag screw
For ducts with P/2 over 73"	3/8"x 1-1/2" lag screw

E. Upper connection in tension to wood shall not be used unless absolutely necessary. Where deemed necessary the contractor shall submit calculations to show the size fastener and penetration required to support loads in tension from wood in accordance with the following schedule:

For ducts with P/2=30"	260 pounds per hanger
For ducts with P/2=72"	320 pounds per hanger
For ducts with P/2=96"	460 pounds per hanger
For duct with P/2 larger than 120"	NOT ALLOWED

- F. Install concrete inserts for support of ductwork in coordination with formwork as required to avoid delays in work.
- G. Upper connection to manufactured truss construction must comply with truss manufacturers published requirements and Structural Engineers requirements.
- H. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct plus insulation with sheet metal flanges of same gauge as duct. Overlap opening on four sides by at least 1-1/2 inches.
- I. Support ductwork in manner complying with SMACNA "HVAC Duct Construction Standards," hangers and supports sections. Where special hanging of ductwork is detailed or shown on Drawings, Drawings shall be followed. Angles shall be attached to overhead construction in a manner so as to allow a minimum of 2 inches of movement in all directions with no bending or sagging of the angle.

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1. Except where modified in individual paragraphs of this Section, provide hanger support with minimum 18 gauge straps, 1 inch wide. Fold duct strap over at bottom of duct.
 2. Install duct supports to rectangular ducts with sheet metal screws. Provide one screw at top of duct and one screw into strap at bottom of duct.
- J. Installation of Flexible Ductwork:
1. Provide flexible ducts with supports at 30 inch centers with 2 inch wide, 26 gauge steel hanger collar attached to the structure with an approved duct hanger. Installation shall minimize sharp radius turns or offsets.
 - a. Supports shall be in accordance with SMACNA HVAC Duct Construction Standards (Metal and Flexible).
 - b. Flexible duct bends shall be not less than 1-1/2 duct diameter bend radius.
 2. Make connections to rigid duct and units with Panduit style draw band at inner liner material, and a second draw band over the outer vapor barrier material.
 3. Make connection to duct with spin-in fittings, with air scoop and balance damper.
- K. Installation of Fabric Duct Air Dispersion System:
1. Install fabric duct system in accordance with the requirements of the manufacturer, and per Drawings details.
 - a. Air handler and associated ductwork shall be clean and free of particulate matter at the time of fabric duct connection and pressurization of duct system.
 2. Fabric duct shall be cleaned according to manufacturers' instructions, if soiled during installation, prior to Project handover to Owner.
- L. Installation of Kitchen Exhaust Ducts (Type 1):
1. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease.
 2. Slope duct a minimum of 2 percent to drain grease back to the hood.

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3. Provide for thermal expansion of ductwork through 2000 °F temperature range.
4. Install listed grease duct access panel assemblies at each change of direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, and as indicated on Drawings. Locate access panel on top or sides of duct. Locate panel so that edge of opening is not less than 1-1/2 inch from all outside edges of the duct or welded seams. For large horizontal ducts, install 20 inch by 20 inch access panel for personnel entry at maximum intervals of 20 feet.
5. Install listed grease duct access panel assemblies in accordance with the terms of their listings and the manufacturers' instructions. Access panels shall be labeled with the words: "Access Panel – Do Not Obstruct."
6. Fabricate ducts with continuous welds for grease-tight construction.
7. Grind welds to provide smooth surface free of burrs, sharp edges and weld splatter. When welding stainless steel with a No. 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to removed discoloration caused by welding.
8. Cover grease exhaust duct with two layers of 1-1/2 inch thick field-applied grease duct enclosure. Install grease duct enclosure in accordance with manufacturer's instructions and listing requirements.

M. Installation of Shower Exhaust Ducts:

1. Slope duct a minimum of 1 percent to drain back to the exhaust grille.

3.08 DUCTWORK SEALING AND LEAK TESTING

- A. All ductwork shall receive a Class A seal.
- B. Seal airtight all joints and seams, including standing seams and manufactured joints and seams, of all supply, return and exhaust ducts except those exposed in conditioned space.

C. Leakage Classes:

Pressure Class	Leakage Class	
	Round Duct	Rectangular Duct
2"W.G. or less	8	16
4"W.G. or greater	2	4

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- D. All duct systems (supply, return, outside air intake, and exhaust), except those identified on compliance forms on Drawings as requiring Acceptance Testing per the requirements of the California Energy Code, shall be tested in accordance with the requirements of SMACNA "HVAC Air Duct Leakage Test Manual." Test pressure shall be equal to the pressure class of the duct. For additional duct leak testing requirements, refer to Section 23 08 00.13, "Title 24 Commissioning of HVAC."

3.09 HANGER AND SUPPORT INSTALLATION

- A. General: Support ductwork, equipment and piping so that it is firmly held in place by approved iron hangers and supports, and special hangers. Hanger and support components shall support weight of ductwork, equipment and pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments or hangers, of same size as pipe or tubing on which used, or nearest available. Rigidly fasten hose faucets, fixture stops, compressed air outlets, and similar items to the building construction. The Architect shall approve hanger material before installation. Where building structural members do not match piping and ductwork support spacing, provide "bridging" support members firmly attached to building structural members in a fashion approved by the structural engineer.
1. Materials, design, and type numbers for support of piping per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.
 - a. Provide copper-plated or felt-lined hangers for use on uninsulated copper tubing.
 2. Materials and design for ductwork support shall be per SMACNA "HVAC Duct Construction Standards, Metal and Flexible."
- B. Hanger components shall be provided by one manufacturer: B-Line, Grinnell, Unistrut, Badger, or equal.
- C. Riser clamps: B-line model B3373, or equal.
- D. Rubber Neoprene Pipe Isolators:
1. Pipe isolators shall comprise an internal rubber or neoprene material that isolates pipe from hanger and structure. Install at all piping located in acoustical walls. Refer to Architectural Drawings for location of acoustical walls.

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2. Isolation material shall be either a rubber or neoprene material that prevents contact between the pipe and the structure. The rubber shall have between a 45 to 55 durometer rating and a minimum thickness of 1/2 inch.
3. Manufacturers:
 - a. Vertical runs: Acousto-Plumb or equal.
 - b. Horizontal runs: B-Line, Vibraclamp; Acousto-Plumb or equal.

E. Pipe Hanger and Support Placement and Spacing:

1. Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.
2. Vertical piping hanger and support spacing: Provide riser clamps for piping, above each floor, in contact with the floor. Provide support at joints, branches, and horizontal offsets. Provide additional support for vertical piping, spaced at or within the following maximum limits:

Pipe Diameter	Steel Threaded or Welded (Note 3)	Copper Brazed or Soldered (Notes 3, 4)	CPVC & PVC (Note 2)
1/2 - 1"	12 ft.	Each Floor, Not to Exceed 10 ft.	Base and Each Floor (Note 1)
1-1/4 - 2"	12 ft.	Each Floor, Not to Exceed 10 ft.	Base and Each Floor (Note 1)
2-1/2 - 3"	12 ft.	Each Floor, Not to Exceed 10 ft.	Base and Each Floor (Note 1)
Over 4"	12 ft.	Each Floor, Not to Exceed 10 ft.	Base and Each Floor (Note 1)

- a. Note 1: Provide mid-story guides.
- b. Note 2: For PVC piping, provide for expansion every 30 feet per IAPMO installation standard. For CPVC piping, provide for expansion per IAPMO installation standard.
- c. Note 3: Spacing of hangers and supports for piping assembled with mechanical joints shall be in accordance with standards acceptable to authorities having jurisdiction.
- d. Note 4: Includes refrigerant piping, including vapor and hot gas pipes.

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3. Horizontal piping, hanger and support spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and spaced at or within following maximum limits:

Pipe Diameter	Steel Threaded or Welded (Note 2)	Copper Brazed or Soldered (Notes 2, 3)	CPVC & PVC (Note 1)
1/2 - 1"	6 ft.	5 ft.	3 ft.
1-1/4 - 2"	7 ft.	6 ft.	4 ft.
2-1/2 - 3"	10 ft.	10 ft.	4 ft.
Over 4"	10 ft.	10 ft.	4 ft.

- a. Note 1: For PVC piping, provide for expansion every 30 feet per IAPMO installation standard. For CPVC piping, provide for expansion per IAPMO installation standard.
 - b. Note 2: Spacing of hangers and supports for piping assembled with mechanical joints shall be in accordance with standards acceptable to authorities having jurisdiction.
 - c. Note 3: Includes refrigerant piping, including vapor and hot gas pipes.
4. Suspended Piping:
- a. Individually suspended piping: B-Line B3690 J-Hanger or B3100 Clevis, complete with threaded rod, or equal. All hangers on supply and return piping handling heating hot water or steam shall have a swing connector at point of support.

Pipe Size	Rod Size Diameter
2" and Smaller	3/8"
2-1/2" to 3-1/2"	1/2"
4" to 5"	5/8"
6"	3/4"

- b. Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power actuated inserts will not be allowed.
- c. Trapeze Suspension: B-Line, or equal, 1-5/8 inch width channel in accordance with manufacturers' published load ratings. No deflection to exceed 1/180 of a span.
- d. Trapeze Supporting Rods: Shall have a safety factor of five; securely anchor to building structure.

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- e. Pipe Clamps and Straps: B-Line B2000, B2400, or equal. Where used for seismic support systems, provide B-Line B2400 series, or equal, pipe straps.
 - f. Concrete Inserts: B-line B22-I continuous insert or B2500 spot insert. Do not use actuated fasteners for support of overhead piping unless approved by Architect.
 - g. Steel Connectors: Beam clamps with retainers.
5. Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.
6. Insulated Piping:
- a. Do not interrupt insulation at pipe hangers and clamps.
 - b. Use thermal hanger shield inserts or MSS protection saddles and shields.
 - c. Thermal Hanger Shield Inserts:
 - 1) Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - 2) Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 3) For below ambient services, maintain continuous vapor barrier.
 - 4) For Clevis or Band Hangers: Install thermal-hanger shield inserts with insulation protection shields.
 - 5) For Trapeze or Clamped Systems: Install thermal-hanger shield inserts with heavy-duty insulation protection shields. Install additional 180-degree galvanized shield for top of support if clamping is required.
 - d. MSS Protection Saddles and Shields:
 - 1) MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 2) MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

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- 3) Shield Dimensions for Pipe: Of length recommended in writing by manufacturer to prevent crushing insulation. Not less than the following:
- (a) NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - (b) NPS 4: 12 inches long and 0.06 inch thick.
 - (c) NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - (d) NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - (e) NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

F. Piping Support to Structure:

1. Wood Structure: Provide and install wood blocking as required to suit structure. Provide lag screws or through bolts with length to suit requirements, and with size (diameter) to match the size of hanger rods required.
 - a. Do not install Lag screws in tension without written review and acceptance by Structural Engineer.

Side Beam Angle Clip	B-Line B3062--MSS Type 34
Side Beam Angle Clip	B-Line B3060
Ceiling Flange	B-Line B3199

- b. Blocking for support of piping shall be not less than 2 inch thick for piping up to 2 inch size. Provide 3 inch blocking for piping up through 5 inch size, and 4 inch blocking for larger piping. Provide support for blocking in accordance with Structural Engineers requirements.
 - c. Where lag screws are used, length of screw shall be 1/2 inch less than the wood blocking. Pre-drill starter holes for each lag screw.
2. Steel Structure: Provide and install additional steel bracing as required to suit structure. Provide through bolts with length to suit requirements of the structural components. Burning or welding on any structural member may only be done if approved by the Architect.

G. Duct Hanger and Support Spacing: Conform to Requirements of CMC and SMACNA "HVAC Duct Construction Standards, Metal and Flexible."

H. Duct Support to Structure:

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1. Upper connection of support to wood structure shall be with wood screws or lag screws in shear fastened in the upper one half of the wood structural member. Fasteners shall conform to the following schedule:

For ducts with P/2=30"	#10 x 1-1/2" wood screw
For ducts with P/2=72"	1/4"x 1-1/2" lag screw
For ducts with P/2 over 73"	3/8"x 1-1/2" lag screw

2. Upper connection in tension to wood shall not be used unless absolutely necessary. Where deemed necessary the contractor shall submit calculations to show the size fastener and penetration required to support loads in tension from wood in accordance with the following schedule:

For ducts with P/2=30"	260 pounds per hanger
For ducts with P/2=72"	320 pounds per hanger
For ducts with P/2=96"	460 pounds per hanger
For duct with P/2 larger than 120"	NOT ALLOWED

3. Install concrete inserts for support of ductwork in coordination with formwork as required to avoid delays in work.
4. Upper connection to manufactured truss construction must comply with truss manufacturers published requirements and Structural Engineers requirements.

3.10 INSULATION AND FIELD-APPLIED JACKET INSTALLATION

A. General:

1. The term "piping" used herein includes pipe, air separators, valves, strainers and fittings.
2. Clean thoroughly, test and have approved, all piping and equipment before installing insulation and/or covering.
3. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, ductwork, and equipment.
4. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.
5. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

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6. Install insulation with longitudinal seams at top and bottom of horizontal runs.
7. Install multiple layers of insulation with longitudinal and end seams staggered.
8. Keep insulation materials dry during application and finishing.
9. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
10. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
11. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
12. For piping, ductwork, and equipment, with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
13. Repair all damage to existing pipe, duct and equipment insulation whether or not caused during the work of this contract, to match existing adjacent insulation for thickness and finish, but conforming to flame spread and smoke ratings specified above.
14. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - a. Install insulation continuously through hangers and around anchor attachments.
 - b. 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.
 - c. 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.

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- d. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

B. Piping Insulation Installation:

1. General:

- a. Apply insulating cement to fittings, valves and strainers and trowel smooth to the thickness of adjacent covering. Cover with jacket to match piping. Extend covering on valves up to the bonnet. Leave strainer cleanout plugs accessible.
- b. Provide removable insulation covers for items requiring periodic service or inspection.
- c. Insulation shall be vapor tight before applying PVC jacket and fitting covers. Verify suitability with manufacturer of insulation.
- d. Provide pre-formed PVC valve and fitting covers for indoor piping.
- e. Provide factory-fabricated aluminum valve and fitting covers for outdoor piping.
- f. Provide Calcium Silicate rigid insulation and sheet metal sleeve, 18 inch minimum length at each pipe hanger. Seal ends of insulation to make vapor tight with jacket.

2. Below-Ambient Services Including Chilled Water Supply and Return and Refrigerant Piping:

- a. Insulate valves and irregular surfaces to match adjacent insulation and cover with two layers of woven glass fiber cloth saturated in Foster Sealfas 30-36, 3M, or equal, extending 3 inches over the adjoining pipe insulation. Finish with a coat of Foster Sealfas 30-36, 3M, or equal. The 3 inch wide SSL end laps furnished with the insulation shall be adhered over the end joints. Seal entire surface of insulation vapor tight, including joints and ends of PVC or aluminum fitting covers.
- b. Variable refrigerant flow (VRF) heat pump systems: Insulation for VRF system refrigerant piping shall be installed according to VRF unit manufacturer's instructions.

3. PVC Jacket Installation:

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- a. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
 - 1) Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

4. Aluminum Jacket Installation:

- a. Where insulated piping is exposed to the weather apply aluminum jacket secured with 1/2 inch stainless-steel bands on 12 inch centers. Install jacketing 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. Cover fittings with glass cloth, two coats of Foster Sealfas 30-36, and factory-fabricated aluminum fitting covers, of same material, finish, and thickness as jacket. Insulation shall be vapor tight before applying metal jacket and fitting covers.
- b. Do not install aluminum jackets on refrigerant flexible connectors to vibration isolated outdoor condensing units. Coat elastomeric insulation with insulation manufacturer's recommended ultraviolet light protective coating.

C. Duct Insulation Installation:

1. General:

- a. Insulation applied to the exterior surface of ducts located in buildings shall have a flame spread of not more than 25 and a smoke-developed rating of not more than 50 when tested as a composite installation including insulation, facing materials, tapes and adhesives as normally applied. Material exposed within ducts or plenum shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50.
- b. Duct insulation applied to the exterior surface of ducts installed outside the building insulation envelope shall meet minimum R-value of R-8 at 3 inches thickness and 3/4 pound per cubic foot density.
- c. Duct insulation applied to the exterior surface of ducts installed within the building insulation envelope shall meet minimum R-value of R-4.2 at 1-1/2 inches thickness and 3/4 pound per cubic foot density.

2. Mineral Fiber Blanket Installation:

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- a. Insulate all unlined concealed supply and return ducts with fiberglass duct wrap, manufactured as a blanket of glass fibers factory laminated to a reinforced foil/kraft vapor retarding facing. Provide 2 inch stapling and taping flange. Wrap insulation entirely around duct and secure with outward clinching staples on 6 inch centers. Provide mechanical fasteners at maximum 18 inch centers for all bottoms of duct which are greater than 24 inches. Lap all insulation joints 3" minimum. Insulate ducts installed tight against other work before hanging in place. Seal all seams, both longitudinal and transverse, and all staple and mechanical fastener penetrations of facing with scrim backed foil tape or recommended sealant, to provide a vapor tight installation.

3. PVC Jacket Installation:

- a. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
 - 1) Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Equipment Insulation Installation:

1. General:

- a. Insulate pumps, coil u-bends where exposed outside airstream, air separators, heating hot water and chilled water storage tanks, and other elements that are in series with the fluid flow, according to the requirements of the California Energy Code.

2. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels:
Secure insulation with adhesive and anchor pins and speed washers.

- a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, and for percent coverage of tank and vessel surfaces.
- b. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
- c. Protect exposed corners with secured corner angles.
- d. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

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- 1) Do not weld anchor pins to ASME-labeled pressure vessels.
 - 2) Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - 3) On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - 4) Do not overcompress insulation during installation.
 - 5) Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - 6) Impale insulation over anchor pins and attach speed washers.
 - 7) Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- e. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
- f. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
- g. Stagger joints between insulation layers at least 3 inches.
- h. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
- i. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

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- j. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
3. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels:
Install insulation over entire surface of tanks and vessels.
- a. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - b. Seal longitudinal seams and end joints.
4. Insulation Installation on Pumps:
- a. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism. Do not enclose or insulate pump motor.
 - b. Fabricate boxes from G90 galvanized steel, at least 0.050 inch thick.
 - c. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.
5. PVC Jacket Installation:
- a. 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.
6. Aluminum Jacket Installation:
- a. Where aluminum 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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3.11 TEMPERATURE CONTROL SYSTEM INSTALLATION

- A. Provide thermostats where indicated on drawings. All wiring shall be in conduit. Provide all relays, transformers and the like to render the control system complete and fully operable. All control conduit to be rigid steel type.

3.12 EQUIPMENT START-UP

- A. Initial start-up of the systems and pumps shall be under the direct supervision of the Contractor.
- B. Equipment start-up shall not be performed until the piping systems have been flushed and treated and the initial water flow balance has been completed.
- C. It shall be the responsibility of the Contractor to assemble and supervise a start-up team consisting of controls contractor, start-up technician, and test and balance contractor; all to work in concert to assure that the systems are started, balanced, and operate in accordance with the design.
- D. After start-up is complete, instruct the Owner's personnel in the operation and maintenance of the systems. Obtain from the Owner's representative a signed memo certifying that instruction has been received.
- E. For additional requirements, refer to article, Check, Test and Start Requirements, in Section 23 00 50, Basic HVAC Materials and Methods.

3.13 TESTING AND BALANCING

- A. For testing and balancing requirements, refer to Section 23 05 93, Testing and Balancing for HVAC.

3.14 CLEANING AND PROTECTION

- A. As each duct section is installed, clean interior of ductwork of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration of metal or where ductwork is to be painted.
- B. Strip protective paper from stainless steel ductwork surfaces, and repair finish wherever it has been damaged.]
- C. Temporary Closure: At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until connections are to be completed.

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- D. As each internally lined duct section is installed, check internal lining for small cuts, tears, or abrasions. Repair all damage with fire retardant adhesive.

3.15 EQUIPMENT MOUNTING

- A. Mount and anchor equipment in strict compliance with Drawings details. Alternate anchorage methods will not be considered for roof mounted equipment.

3.16 INDOOR DUCT INSULATION SCHEDULE

- A. Ducts Located Within Building Thermal Envelope:
 - 1. Minimum R-Value = R-4.2.
 - 2. Supply and Return Ducts: Mineral Fiber Blanket, 1-1/2 inches thick, 0.75 lb/cu. ft.
- B. Ducts Located Within Building Outside Thermal Envelope:
 - 1. Minimum R-Value – R-8.0.
 - 2. Supply and Return Ducts: Mineral Fiber Blanket, 3 inches thick, 0.75 lb/cu. ft.

3.17 OUTDOOR DUCT INSULATION SCHEDULE.

- A. Minimum R-Value = R-8.
- B. Refer to article, Ductwork, for internal duct lining. Provide 2 inches thick internal duct lining where indicated on Drawings.

3.18 INDOOR FIELD-APPLIED DUCT JACKET SCHEDULE

- A. Insulated ducts in concealed spaces: None.
- B. Insulated ducts in exposed unconditioned spaces: PVC, 20 mils thick.

END OF SECTION

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 CONTRACT PROVISIONS

- A. The requirements of this Section are in addition to the requirements of Division 1, General Conditions and Supplementary Conditions.

1.02 SUMMARY

- A. This section describes the requirements for the electrical work includes, among others, the furnishing and installation of the following:

1. Electrical service from the Main Switchboard to the building Distribution Panel(s) including transformer(s), conduit and trenching, conductors.
2. Power distribution system.
3. Grounding system.
4. Lighting and lighting control systems.
5. Wiring systems including power wiring to plumbing and HVAC and other misc. appliances and equipment.
6. Electrical services (power) for Communications management system. (voice/video/media/clock) as described in Division 27 and as indicated on the drawings.
7. Electrical services (power) for Computer data systems, as described in Division 28 and as indicated on the drawings to include outlets, raceways, and cabling.
8. Electrical services (power) for Intrusion alarm and security systems as described in Division 28 and as indicated on the drawings.
9. Emergency egress lighting.
10. Testing and commissioning for all electrical work installed under this contract and as described in these specifications and indicated on the drawings.

- B. Furnish and install all electrical equipment and systems as shown on the Drawings and as described in this Division of the Specifications to provide a complete and functional electrical installation. This work includes but is not limited to all material and labor required for installation of electrical and special

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systems complete as described herein this specification and drawings; and connections (and installation where not otherwise provided for) of electrical equipment furnished by others. Provide and install all items of equipment, devices, supports, etc., which are incidental to the major components shown on the Drawings or described in these Specifications.

1.03 DEFINITIONS

- A. The meaning of words shall be as defined in the CEC Article 100, Definitions, unless defined otherwise in an individual specification section.
- B. The following specification development organizations are referenced throughout the various specification sections of Division 26:
 - 1. ADAAG – Americans with Disabilities Act Accessibility Guidelines.
 - 2. ANSI – American National Standards Institute.
 - 3. AQMD – Air Quality Management District.
 - 4. ASME – American Society of Mechanical Engineers.
 - 5. ASTM – American Society for Testing and Materials.
 - 6. FCC – Federal Communications Commission.
 - 7. ICC - International Code Council
 - 8. 21. IEEE – Institute of Electrical and Electronic Engineers.
 - 9. ISO – International Organization for Standardization.
 - 10. 27. NECA – National Electrical Contractors Association.
 - 11. 28. NEMA – National Electrical Manufacturing Association.
 - 12. 29. NETA – National Electrical Testing Association.
 - 13. 30. NFPA – National Fire Protection Association.
 - 14. 32. OSHA – Occupational Safety and Health Administration.
 - 15. 34. UL – Underwriters Laboratories.

1.04 RELATED WORK INCLUDED IN OTHER DIVISIONS

- A. Finish painting except factory applied finishes and repair of factory finishes shall be provided in accordance with appropriate sections of this Specification.

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Coordinate "painting" requirements of this Division with other trades as required to assure timely and satisfactory completion of required work. In finished areas, all exposed raceway, boxes, galvanized steel box covers (where allowed), and other electrical "structure" shall be finished to match adjacent structures. Verify that all raceway openings are closed and box covers are in place prior to finishing work done by others.

- B. Examine the drawings and specification for mechanical and plumbing equipment and provide electrical installation for heating, ventilation and air conditioning equipment, motors, pumps and associated motor starters and controls as described in Division 22 and Division 23.
- C. Examine the Architectural drawings and specification for electrical appliances and equipment which may not be shown on the plans to include and provide electrical installations as described in the architectural division of work.
- D. Examine the Architectural drawings and provide all construction necessary to maintain the integrity of the fire rated barriers.
- E. Examine the Architectural drawings and coordinate with the Architect to provide access doors, whether shown on drawings or not, where floors, walls, or ceiling must be penetrated for access to electrical equipment, outlet boxes, devices, etc., and as specified in this specification.
- F. Provide and install, as part of the work described in this Division, all power and control wiring fed from a source of 30 Volts or more (i.e. all wiring except temperature control wiring) for mechanical equipment described in Division 23.
- G. Examine the fire sprinkler system drawings and specifications for electrical work which may not be shown on the electrical and/or fire detection and alarm plans to be included in the electrical work as necessary as described in the Division 21 fire sprinkler system.

1.05 APPLICATION OF OTHER DIVISIONS

- A. Where carpentry, masonry, concrete work, painting, etc., is required in the installation of equipment specified under this Division, the work shall be done in accordance with the applicable Division of these Specifications. This work could include for example: work associated with panelboard installation, equipment pads or bases, support structures, etc.

1.06 DRAWINGS AND SPECIFICATIONS

- A. The information presented in these Specifications, and on the drawings, is intended to describe the utilitarian and physical aspects of the systems shown

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as well as the quality of the entire installation. All information is as complete and thorough as possible, but every condition or situation cannot be anticipated. Exact locations, dimensions, elevations, etc. must be determined "on the job" with careful attention to the "intent" of the Drawings and Specifications.

- B. The above paragraph shall not be construed as to allow significant deviation from either the Drawings or Specifications without prior approval of the Architect, but minor changes in conduit routing or equipment locations may be required or desired due to specific conditions encountered. This work shall be accomplished in accordance with these Specifications and no "extra charges" are to be created for any unanticipated labor or material.
- C. Any error or omissions of detail in either the drawings or the specifications shall not relieve the Contractor from correctly installing all materials necessary for complete and operating electrical systems.
- D. Contractor shall inspect the site and verify all measurements and conditions. No extra compensation will be allowed because of differences between work shown on the drawings and measurements at the site.
 - 1. The Drawings are diagrammatic in nature, but the locations of devices, equipment, outlets, and lighting fixtures are shown approximately where installations are intended. Architectural, structural, mechanical, audio/video, theatrical lighting and other drawings shall be examined, noting all conditions that may affect this work. Report conflicting conditions to the Architect/Engineer for adjustment before proceeding with the work. Should the Contractor proceed with work without reporting the matter, he does so on his own responsibility and shall alter work if directed by the Architect/Engineer at his own expense.
- E. Examine the architectural, structural, mechanical, fire sprinkler and manufacturer's drawings for various equipment in order to determine exact routing and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.
- F. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Owner reserves the right to require minor changes in location of outlets or equipment, prior to rough in without incurring any additional cost or changes.
- G. If significant departures from the Drawings or Specifications are considered necessary by the Contractor, details of the changes and the reasons therefore shall be submitted to the Architect as within thirty days after award of

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contract. Prior written acceptance of the Architect is required for these departures.

- H. Clarification of plans and specifications for the purpose of facilitating construction, but not involving additional labor and materials, may be prepared during construction by the Architect/Engineer. Said revised plans and specifications shall become a part of the contract. The Contractor shall conform to the revised plans and specifications at no additional cost to the Owner.

1.07 CODES, STANDARDS, RULES AND REGULATIONS

- A. All work and materials shall be in full accordance with the latest rules, codes, and/or regulations and not limited to the following:
- B. California Building Standards Code (California Code of Regulations - Title 24)
- C. NFPA 70 - National Electrical Code; National Fire Protection Association, 2020 with 2022 California Electrical Code amendments
- D. NFPA 72 - Fire Alarm Code
- E. NFPA 101 - Life Safety Code
- F. City and County Electrical Codes as applicable.
- G. Utility rules and regulations.
- H. Any applicable additional codes and regulatory documents effective at the project site.
- I. Nothing on the Drawings or in the Specifications shall be construed to allow work not in conformance with these rules, codes, and regulations.
 - 1. The Drawings and/or Specifications shall take precedence where work and material described therein exceeds that required by rules, codes, or regulations.

1.08 MANUFACTURER'S INSTRUCTIONS

- A. Follow the manufacturer's instructions when specific installation or connection details are not indicated or specified on the contract documents.
- B. Notify the Architect/Engineer of conflicts between the manufacturer's instructions and installation or connection details prior to the installation of materials.

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1.09 WORKMANSHIP

- A. High quality workmanship shall be evidenced in the installation of all electrical equipment and materials. Use the National Electrical Contractors Association's "Standard of Installation" as a guide to the workmanship required. Be prepared to replace or repair any material or equipment damaged by or installed in a manner exhibiting evidence of poor workmanship.

1.10 COORDINATION WITH OTHER TRADES

- A. Examine the Electrical Drawings and refer to the Drawings and Specifications describing other work to be accomplished. Verify and coordinate prior to bid. Continue to coordinate work planning and all work in the field to avoid conflicts, errors, and/or delays. No compensation will be allowed for extra work necessitated by lack of coordination.

1.11 AUTHORITY OF THE ARCHITECT

- A. As used in this paragraph only, the word "Architect" shall mean the Architect of record or his designated representative.
- B. The authority of the Architect shall be absolute with respect to all performance under this Specification. In case of dispute, the decision of the Architect shall be final.
- C. Where optional materials, methods, or installation techniques are allowed under the provisions of this Specification, they may be used at the discretion of the Architect. The Architect may require specific materials, methods, or techniques to be used in specific situations where use of other materials, methods, or techniques might in his judgment result in loss of aesthetics, accidental damage, life safety hazard, or loss of utility over the system design lifetime.
- D. No additional charges will be allowed for work or material require to be supplied under the conditions of this paragraph unless the need for such material or work could not have been anticipated by thorough study of the site, Drawings, and Specifications and knowledge of all applicable codes, laws, and ordinances.

1.12 EXAMINATION OF THE SITE

- A. The contractor is required to visit the site of construction prior to bid to determine existing conditions and their effect upon the work he will be required to perform. No additional compensation will be allowed for any extra expenses

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incurred by failure to detect and evaluate all existing conditions that will affect his work to be included in the bid to accomplish this contract document's goal.

1.13 STRUCTURAL REQUIREMENTS

- A. Secure all anchors for electrical equipment in a manner, which will not decrease the structural value of any structure to an unsafe level. Install all equipment, fixtures, etc. to resist seismic movements. Inform the Architect in advance and provide drawings of any proposed modifications to the structure that involves cutting or patching of concrete, masonry, steel, or wood in this project.

1.14 PERMITS, FEES, AND, INSPECTIONS

- A. Obtain all permits and licenses as required and pay all fees incidental to construction.
- B. Inspections required by prevailing Local Authorities, and/or ordinances, shall be coordinated and arranged by the contractor. Provide the Architect with a schedule of inspections, where applicable, and submit all certificates of inspection to the Architect.
- C. The Contractor shall cooperate with the Architect and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate equipment, or perform any reasonable work, which, in the opinion of the Architect, will be necessary to determine the quality or adequacy of the work. Work shall not be closed in or covered before inspection and approval by the Architect. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor. If any material does not conform with these specifications the Contractor shall, within three days after being notified by the Architect, remove the materials from the premises.

1.15 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable to the Owner. Secure material from weather or accidental damage.

1.16 SEQUENCING AND SCHEDULING

- A. Sequence work under provisions of Division 1.

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- B. Coordinate the incoming electrical, telephone and cable television services with the local serving utility companies. Install utility service trench and duct systems in accordance with the respective serving utility company requirements.
- C. Coordinate hand hole locations with the existing site conditions. Hand holes are to be located approximately five feet from building or as indicated on drawings.

1.17 SHORT CIRCUIT AND PROTECTIVE DEVICE COORDINATION STUDY

- A. The contractor shall provide short circuit, protective device and arc flash studies for the complete electrical distribution system. Submit to the Electrical Engineer of Record for review. Provide all short circuit device and equipment characteristic information for all electrical components. Provide Time-Current curves for all overcurrent protective devices in the submittal. Set and adjust all devices in accordance with the results of this study prior to energizing equipment. Refer to Section 26 05 73, Power Systems Studies for additional requirements.
- B. The Contractor shall be responsible for obtaining all pertinent information necessary in order to perform the required short circuit, protective device coordination and arc flash studies to include but not limited to the following:
 - 1. Contacting the serving power utility to obtain the available short circuit current at the project point of connection and/or secondary of the serving utility company service transformer(s).
 - 2. Field investigation to determine the short circuit current rating for any existing electrical service and distribution equipment.
 - 3. Electrical characteristics for all proposed new electrical service and distribution equipment.
 - 4. The Contractor shall provide approved permanent labels for all electrical service and distribution equipment to clearly identify the available short circuit current and arc flash energy levels and required PPE (Personnel Protective Equipment).

1.18 OPERATING INSTRUCTIONS

- A. Instruct the Owner as to function, operation, maintenance, and adjustment of each system and piece of equipment provided.

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1.19 RECORD DRAWING

- A. The Contractor shall keep a separate set of Electrical Drawings at the job site to be used as RECORD Drawings. These Drawings are to be kept current and in a neat and clean condition at all times. They are to be available for inspection by the Architect or Engineer at any time during site visitations. These Drawings shall be "red lined" to indicate all changes in equipment, device, and outlet locations; and to indicate the true locations of all concealed or underground work where different from that shown on the Drawings. Each sheet of this set shall be clearly and permanently marked "RECORD DRAWINGS".
- B. Upon completion of the project and prior to final payment, transfer all RECORD DRAWINGS information to the provided original drawings. All information shall be clearly drawn with "RED" ink. The drawings shall be scanned, 100% edited, and converted into an AutoCAD ".dwg" version 2011 (or higher) electronic file. Deliver the original, final sets, and electronic files (CD) to the Architect for review and delivery to the Owner.

1.20 SPARE PARTS

- A. Spare parts shall be provided and maintained by the Contractor to support the maintenance response requirements defined in this document.
- B. At a minimum, the following spare parts shall be stored onsite at a location identified by the Owner's representative. The spare parts shall be the property of the Owner. The spare parts shall be of the same type submitted and installed in the facility to include the following:
 - C. Lighting fixture LED driver, one for each fixture type.
 - D. Branch circuit panelboard circuit breaker, one for each circuit breaker type.
 - E. Fuses, one set of three for each fuse type and size.
 - F. Lighting occupancy sensors and switches, one for each sensor and switch type.

1.21 GUARANTEE

- A. All electrical work, material, and equipment shall be guaranteed to be free from defects in workmanship or material for a period of two (2) year from the date of final acceptance. Repair or replace all such defects in a timely manner and any damage to the owner's property resulting from such defect or repair thereof. All

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equipment and material provided and all work accomplished under the requirements of this section shall be at no expense to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Unless specifically indicated otherwise, all material shall be new and free from defects; it shall be listed by Underwriters' Laboratories where applicable. Like items shall be of the same manufacturer (except lighting fixtures - which shall be as specified).
- B. Except as noted otherwise, where material of a particular manufacturer is specified, the intent is to describe the quality and function of the item. The term "...or acceptable equal" is implied. A substitution of any of these items will require that the item be presented in a submittal whether specifically listed in the "Submittals" paragraph below or not.

2.02 SUBMITTALS

- A. Material submittals shall be complete and submitted all at the same time. The individual groups of submittal types (e.g.: lighting fixtures, wiring devices, distribution equipment, etc.) MUST be prefaced with a list of contents identifying each item by its project name or symbol, manufacturer, and complete catalog number. Each copy of each submittal group shall have the list of contents attached. These lists will be used to report submittal comments. The Contractor is responsible for submitting this information in a timely manner so that material may be ordered early enough to meet the construction schedule. If material is not ordered in time for whatever reason, pay such premium prices and special handling charges as are required to meet the construction schedule. No substitution of an "accepted" item will be allowed due to failure to plan for adequate material procurement lead time.
- B. Shop drawings shall be drawn to scale or completely dimensioned and shall give all information required to completely describe the item. The Contractor shall carefully check all the shop drawings for compliance with these specifications and the Plans.
- C. If the shop drawings show variations from the Contract requirements because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in order that if (acceptable) suitable action may be taken for proper adjustment of the Contract. The Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract, even though the shop drawings have been reviewed.

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- D. Work requiring shop drawings shall not be started before receipt of the Architect's review and acceptance.
- E. The Architect's/Engineer's review of the submitted materials, items and shop drawings are for general compliance with the plans and specifications and general design and arrangement only. Therefore, it shall not relieve the Contractor from responsibility for errors of any sort in the materials, items, shop drawings or schedules. The Contractor shall verify all dimensions and job site conditions affecting the work, and shall be responsible for furnishing and installing the proper materials required by the Contract, whether or not indicated on the drawings and specifications.
- F. As a minimum, submittals are required for the following items:
 - 1. RACEWAY COMPONENTS
 - 2. WIRE AND CABLE
 - 3. WIRING DEVICES
 - 4. MAIN SWITCHBOARD AND DISTRIBUTION PANELS
 - 5. PANELBOARDS
 - 6. PHOTOVOLTAIC SYSTEM
 - 7. PULL BOXES
 - 8. SAFETY SWITCHES, DISCONNECTS AND CIRCUIT BREAKERS
 - 9. TRANSFORMERS
 - 10. LIGHTING FIXTURES, CONTROL SYSTEMS, PEDESTALS AND POLES
 - 11. EMERGENCY GENERATOR AND TRANSFER SWITCH(ES)

2.03 SUBSTITUTIONS

- A. Specific brand names and catalog numbers are used to describe materials in order to establish of performance and quality.
- B. Only one substitution will be considered for any item. Substitute materials must be equal in quality and function to that specified. Allowance of a substitution does not permit any reduction of system performance or utility, and the Contractor is responsible for additional costs incurred due to use of a substituted item. If the proposed substitute item is "rejected", the specified item shall be provided (re-submittal required) without further discussions or delay.

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- C. Any Contractor's proposed substitution of material, article, or method in the opinion of the Architect/Engineer are equal to that specified will be accepted, provided the Contractor submits a single written request, in triplicate, to the Architect, with the following information for each item:
 - D. Name of Manufacturer or supplier.
 - E. Trade or brand names.
 - F. Type, model, style, and/or catalog number.
 - G. Size or capacity rating.
 - H. After receipt of a written request from the contractor, the engineer of record will review product substitutions fourteen (14) days prior to the bid date. If system substitutions are submitted after the award of the project contract, the analysis for the whole system substitution will be charged to the contractor at senior engineer hourly rates.
 - I. The decision of the Architect/Engineer shall govern as to what is equal to the item specified in the plans and specifications. Equality will be judge on the basis of the following:
 - 1. Conformance with description or performance required.
 - 2. Equal in quality.
 - 3. Comparable in appearance and artistic effect where these are in considerations.
 - 4. Comparable operation, maintenance and performance.
 - 5. Equal in longevity and service under conditions of climate and usage.
 - 6. Conformance with space allocations and requirements for operations from in details and construction of related work.
 - 7. Conformance with all applicable codes and regulations.
 - J. If the Architect/Engineer considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased laboratory, satisfactory to the Architect.

2.04 ENCLOSURES

- A. Provide enclosures suitable for the specific type of location in which they are installed.

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1. Provide NEMA 1 or NEMA 12 boxes and enclosures for dry locations. Dry locations are all indoor areas that do not fall within the definitions below for wet or damp locations.
2. Provide NEMA 3R boxes and enclosures for wet locations. Wet locations are all locations exposed to weather, whether under a roof or not.
3. Provide NEMA 4 boxes and enclosures for damp locations. Damp locations are all indoor spaces wholly or partially underground or any area subject to water spray.
4. Provide NEMA 4X, stainless steel enclosures in all kitchen and wash down areas.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All equipment shall be set square and plumb, securely mounted, adequately supported, and permanent. Provide workspace around items of electrical equipment as required by California Electrical Code (CEC). In general, equipment is to be installed in accordance with manufacturer's instructions; but the requirements of these specifications shall take precedence where conflicts exist.
- B. WIRING METHODS: The cables and conductors of all systems specified in the Specification are required to be installed in raceway.
- C. Coordinate electrical work with the Owner's representative and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the facility during construction.
- D. Check and coordinate the approximate locations of electrical stub-ups, light fixtures, electrical outlets, equipment, and other electrical system components shown on the Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify the architect in writing. The architect's decision shall govern. Make modifications and changes required to correct conflicts as required.

3.02 ELECTRICAL WORK FOR EQUIPMENT PROVIDED UNDER OTHER SECTIONS

- A. Install power conductors and terminate on equipment provided under other specification sections. Verify specific requirements.

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- B. Install and terminate electrical controls as described on the Electrical Drawings (For mechanical equipment specified in Division 23).
- C. Line voltage control wiring of exhaust fans is to be accomplished under this Division. The controlling device may be specified elsewhere.
- D. Provide and install all disconnect/safety switches and motor starters except those devices specified to be furnished with equipment specified elsewhere.
- E. Unless provided for in another Division, install all items of electrical equipment provided by others.
- F. Assist others in equipment testing to verify that wiring and connections made under this Division are correct.

3.03 EQUIPMENT IDENTIFICATION

- A. Nameplates shall be installed on all items of electrical equipment as follows: switchboard(s) and switchboard circuit breakers, panelboards, terminal cabinets, time switches, contactors, motor control switches, wall switches (where noted on the Drawings), motor starters provided under this Division where the function is not immediately obvious, and safety switches.
- B. The nameplate shall identify the item by Drawing name where applicable and describe its use or function in this installation.
- C. Permanently mark all utility outlets to show source of power panel and circuit breaker number.
- D. Provide nameplates per Section 26 05 53.

3.04 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall be accomplished as required for installation of electrical equipment as shown on the Drawings. Restore all surfaces, roadways, walks, etc., and any existing underground structures which might be disturbed during this work to their original condition in a manner acceptable to the Architect.
- B. Trenches shall be straight except where otherwise indicated. Depth shall be as noted on the Drawings and at least as required to provide the minimum cover specified by applicable codes and regulations for the equipment installed. Bottom of trench shall be smooth and free of any rock points. Place a 4" sand bed in trench if these conditions cannot be met with native material.

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- C. Backfill shall be clean and free of rocks and debris. Backfill is to be tamped in 6" layers to nominal 95% compaction using a mechanical tamper manufactured specifically for this purpose. In an area of engineered fill or other area of specified compaction, backfill shall be compacted to match that specified for that area.
- D. At a depth of 12" below finished grade and at least 6" above installed equipment, lay a 6" wide red warning tape on the compacted backfill for the full length of the trench. Do not stretch the tape. Use Brady "Identoline" stating: "CAUTION BURIED ELECTRICAL LINE". Installation under building slabs is not required unless noted otherwise.
- E. If at any time during a period of one-year dating from the date of final acceptance of the project, there shall be any settlement of conduit trenches, the Architect may notify the Contractor to immediately provide additional fill and to make such repairs or replacements in paving, planting, or structures, as may be deemed necessary at the Contractor's expense.
- F. Cooperate and coordinate with others in planning for and execution of all trench work.
 - 1. The Contractor is expected to exercise due care when excavating in an area of existing utilities to avoid damage to these facilities. Where it can be determined that underground facilities are likely to exist (either from the Drawings or inspection of the site), the Contractor is required to determine the exact locations of these existing installations. Damage to existing facilities, due to failure to properly accomplish the above, shall be repaired at the Contractors expense to the approval by the Architect and satisfaction of the Owner.
 - 2. CALL AN UNDERGROUND SERVICE FIRM BEFORE TRENCHING, CALL U.S.A. (800) 624-2444.

3.05 SEALING PENETRATIONS

- A. Flash and counter flash roof and wall penetrations with equipment manufactured for the purpose and as described in other Divisions of these Specifications or as Directed by the Architect. Apply mastic as required to seal absolutely watertight.
- B. Conduits penetrating floor slabs or block or concrete walls shall be grouted and sealed watertight.

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3.06 CUTTING AND PATCHING

- A. Obtain the Architect's acceptance prior to cutting existing surfaces or surfaces under construction. All such surfaces must be repaired or patched to the satisfaction of the Architect.
- B. Structural members shall in no case be drilled, bored, or notched in such a manner that will impair their structural value. Cutting of holes, if required, shall be done with core drill and only with the approval of the Architect and Structural Engineer.
- C. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- D. Cut, remove, and legally dispose of selected electrical equipment, components and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new work.
- E. Protect the structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.
- F. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- G. Patch existing surfaces and building components using experienced installers and new materials matching existing materials and the original installation. For installers' qualifications refer to the materials and methods required for the surface and building components being patched.
- H. Application of joint sealers:
 - 1. General: Comply with joint sealer Manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 2. Installation of fire-stopping sealant: Install sealant, including forming, packing and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops and fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

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3.07 EQUIPMENT ANCHORING

- A. Seismic Withstand Requirements: Freestanding or wall-hung equipment shall be anchored in place by methods, which will meet the requirements of the applicable codes for seismic loads. The contractor shall submit calculations in accordance with "Contractor Submittals", for the design of the anchoring systems for all equipment, including panels, transformers, etc. in excess of 250 pounds. Calculations shall be performed, signed and stamped by a Structural Engineer or a Civil Engineer experienced in structural design and licensed in the State of California. The calculation shall provide an analysis of lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. The calculation shall also provide an analysis of both the anchoring system and the foundation or wall system to receive the anchor loads and shall show that the foundation is capable of resisting all anchor loads. Submittal shall include data on attachment hardware and methods that will satisfy withstand criteria.
- B. Seismic bracing for light fixtures cable or pendant suspended from ceiling or roof structure shall be seismically braced to prevent fixture from swaying 45 degree in either direction of suspension point. Contractor shall use same cable used to suspend light fixture. Where pendants are use the contractor shall use air craft light fixture suspension cable. Submittal shall include data on attachment hardware and methods that will satisfy withstand criteria referred to in above paragraph.

3.08 HOUSEKEEPING PADS AND FOUNDATIONS

- A. Concrete work required for housekeeping pads and foundations shall be provided by General Construction Work.
- B. Furnish required dimensional drawings and specify locations for all equipment pads and foundations. Minimum height of housekeeping pads shall be four inches and shall extend out six inches from the footprint of the equipment. Extend pad dimensions where required to maintain accessibility and meet all code requirements.
- C. Furnish anchor bolts and sleeves, verify accuracy of installation.
- D. Provide housekeeping pads for the following:
 - 1. Outdoor switchboards.
 - 2. Emergency and/or Stand-by generator.
 - 3. Outdoor distribution panels.

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4. Outdoor floor mounted transformers.
5. Other equipment as required or as noted on the drawings.

3.09 PROTECTION CLEANING AND REPAIRS

- A. All electrical equipment shall be protected from damage or degradation during construction. Electrical equipment stored or installed shall be protected from dust, water, or damage from other sources.
- B. After all other work has been accomplished, such as plastering, painting, etc., and prior to final review by the Architect; all electrical equipment, especially equipment enclosures, panelboards, switchboards, and lighting fixtures shall be thoroughly cleaned (inside and out) of all dirt, water, grease, plaster, paint, or other construction debris. All surfaces shall be clean and in "new" condition. All scratches, dents, marks, cracks, etc., shall be repaired to the satisfaction of the Architect or the equipment shall be replaced at no additional cost.

3.10 FIELD QUALITY CONTROL

- A. General testing requirements:
 1. The purpose of testing is to ensure that all tested electrical equipment, both Contractor and Owner supplied, is operational and within industry and Manufacturer's tolerances and is installed in accordance with design Specifications.
 2. Tests and inspections shall determine suitability for energization.
 3. Perform tests in presence of the Owner's Representative and furnish test equipment, facilities and technical personnel required to perform tests.
 4. Tests shall be conducted during the construction period and at completion to determine conformity with applicable codes and with these Specifications.
- B. Tests: In addition to specific system test described elsewhere, tests shall include:
 1. Equipment operations: Test motors for correct operation and rotation.
 2. Lighting control circuits: Test lighting circuits for correct operation through their control devices.

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3. Alarm and interlock systems: Produce malfunction symptoms in operating systems to test alarm and interlock systems. In addition, all specific tests described in the fire alarm system shall be performed.
 4. Circuit numbering verification: Select on a random basis, various circuit breakers within the panelboards and cycle them on and off to verify compliance of the typed panel directories with actual field wiring.
 5. Voltage check:
 - a. At completion of job, check voltage at several points of utilization on the system that has been installed under this Contract. During test, energize all installed loads.
 - b. Adjust taps on transformers to give proper voltage, which is 118 to 122volts for 120volt nominal systems and proportionately equivalent for higher voltage systems. If proper voltage cannot be obtained, inform the Owner and the serving Utility Company.
- C. Contractor shall provide test power required when testing equipment before service energization and coordinate availability of test power with General Contractor after service energization. The Contractor shall provide any specialized test power as needed or specified herein.
- D. Testing safety and precautions:
1. Safety practices shall include the following requirements:
 - a. Applicable State and Local safety operating procedures.
 - b. OSHA.
 - c. NSC.
 - d. NFPA 70E.
 2. All tests shall be performed with apparatus de-energized and grounded except where otherwise specifically required ungrounded by test procedure.
- E. Calibration of test equipment:
1. Testing Agency shall have calibration program that assures test instruments are maintained within rated accuracy.

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2. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a. Field instruments: Analog, 6-months maximum; Digital, 12-months maximum.
 - b. Laboratory instruments: 12-months.
 - c. Leased specialty equipment: 12-months where accuracy is guaranteed by lessor.
 3. Dated calibration labels shall be visible on test equipment.
 4. Records, which show date and results of instruments calibrated or tested, must be kept up to date.
 5. Up-to-date instrument calibration instructions and procedures shall be maintained for test instrument.
 6. Calibration standards shall be of higher accuracy than instrument tested.
 7. Equipment used for field testing shall be more accurate than instrument being tested.
- F. Coordinate with General Contractor regarding testing schedule and availability of equipment ready for testing.
- G. Notify Owner and Engineer one week in advance of any testing.
- H. Any products which fail during the tests or are ruled unsatisfactory by the Owner's Representative shall be replaced, repaired, or corrected as prescribed by the Owner's Representative at the expense of the Contractor. Tests shall be performed after repairs, replacements or corrections until satisfactory performance is demonstrated.
- I. Testing Agency shall maintain written record of tests and shall assemble and certify final test report.
- J. Include all test results in the maintenance manuals.

3.11 ELECTRICAL EQUIPMENT DELIVERABLES

- A. Retain and safeguard all detachable and spare devices, equipment, and literature (O&M manuals, instruction books, wiring diagrams, test reports, keys, fixtures, etc.) until completion of work. At this time, all items will be delivered to the Owner as directed by the Architect.

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3.12 TESTS

- A. Prior to energization of equipment, check the insulation resistance of listed circuits, with a 500 volt "Megger".
- B. Take precaution during the testing period to insure the safety of personnel and equipment.
- C. Test all wiring for continuity and grounds before any fixtures or equipment are connected. Where such tests indicate faulty installation or other defects, the fault(s) shall be located and repaired at the Contractor's expense. The repaired installation shall then be retested.
- D. Verify rotation of all three phase motors and reconnect if necessary.
- E. Verify the resistance of the grounding electrode system(s).
- F. Balance all loads on each panelboard and all other types of distribution equipment as applicable.
- G. Provide all site testing under provisions of Section 26 08 13.

3.13 ADJUSTING

- A. Inspect all equipment and put into good working order.

3.14 CLEANING

- A. Clean work under provisions of Division 1.
- B. Clean all electrical items. Fixtures and equipment shall be free of dirt, dust and other construction debris.
- C. Prior to energizing of electrical equipment, the Contractor shall thoroughly clean the interior of enclosures from construction debris, scrap wire, etc. using Manufacturer's approved methods and materials.
- D. Upon completion of Project, prior to final acceptance, the Contractor shall thoroughly clean both the interior and exterior of all electrical equipment per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt, and debris.
- E. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

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3.15 START UP

- A. Operate all electrical systems in good working order for a period of five consecutive days at a time period agreed to by the Owner's representative.
- B. Training:
 - 1. At the time of completion, a period of not less than 4-hours shall be allotted by the Contractor for instruction of building operating and maintenance personnel in the use of all systems. This 4-hour training is in addition to any instruction time called out in the Specifications for specific systems. All personnel shall be instructed at one time, the Contractor making all necessary arrangements with Manufacturer's Representative. The equipment Manufacturer shall be requested to provide product literature and application guides for the users' reference. Costs, if any, for the above services shall be paid by the Contractor.
 - 2. All training sessions shall be video recorded. Confirm file type, i.e. MOV, AVI, MP4, etc. with the district. Each specification section that requires training shall include one file, and all Division 26 specifications shall be stored on a flash drive (USB3.0, 1TB min.) 3 flash drives shall be provided to the district representative with closeout documentation.
- C. Special tools: Provide one of each tool type required for proper operation and maintenance of the equipment provided under this Section. All tools shall be delivered to the Owner at the Project completion.
- D. Keying: Provide two keys for each lock furnished under this Section and turn over to Owner.

END OF SECTION

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SECTION 26 05 05 - SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical demolition.
- B. The requirements of this Section are in addition to the requirements of Division 1 – General Conditions and Supplementary Conditions.

1.02 RELATED REQUIREMENTS

- A. Section 01 70 00 - Execution and Closeout Requirements: Additional requirements for alterations work.
- B. Section 02 84 00-Polychlorinate Biphenyl (PCB) Remediation: Removal of equipment and materials containing substances regulated under the Federal Toxic Substances Control Act (TSCA), including but not limited to those containing PCBs and mercury.
- C. Section 26 05 00-Common Work Results for Electrical.

1.03 SUBMITTALS

- A. See Section 01 30 00-Administrative Requirements, for submittal procedures.
- B. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

1.04 REQUIREMENTS INCLUDED

- A. The Contractor shall furnish materials, equipment, and labor necessary to perform and complete demolition work.
- B. The work includes demolition of the existing electrical system and equipment.
- C. The work shall include, but not limited to. Removal of existing electrical equipment and devices, conduits, and wiring.
- D. Manufactured articles, materials, equipment, and accessories shall be demolished in accordance with the manufacturer's specifications and recommendations, and industry standards.
- E. Notify the Owner's Representative at least 72 hours prior to any electrical systems shutdown and receive approval prior to proceeding.

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1.05 PROTECTION

- A. It is essential that there be minimal interruption of existing systems such as power, fire protection, and other systems, in addition to the normal operations of the Owner's facilities.
- B. Take care to ensure that there will be no damage to structural elements or portions there-of-which are not to be removed. Erect and maintain temporary shoring, bracing and other means to safeguard the structural integrity of the existing building(s) and structures.
- C. Erect and maintain temporary bracing, shoring, lights, barricades, signs, and other means to protect the public, workers, and other persons; finishes, and improvements to remain; and adjoining property from damage from demolition work; all in accordance with applicable regulatory requirements.
- D. Protect existing structures, facilities, and plant life from damage. Items damaged as a result of demolition operations shall be repaired or replaced, at no cost to the Owner.
- E. Perform demolition to provide the least interference and most protection to existing facilities and improvements to remain.
- F. Demolish concrete in small sections.
- G. Perform demolition as much as possible with small tools.
- H. Jackhammering:
 - 1. Jackhammering will be permitted only to a limited degree, and only with the prior written approval of the Owner.
 - 2. Do not jackhammer within 2-inches of reinforcing or structural steel to remain; remove final 2-inches of material with chipping gun.

1.06 CUTTING AND PATCHING

- A. Make new openings neat, as close as possible to profiles indicated, and only to extent necessary for new work.
- B. Do not cut or alter structural members unless specifically indicated or approved, and do not damage reinforcing or structural steel to remain.
- C. At concrete, masonry, paving, and other materials where edges of cuts and holes will remain exposed in the completed work, make cuts using power-sawing and coring equipment. Do not over cut at corners of cut openings – saw

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overruns will not be permitted. Core hole at corner of proposed openings to insert blade and chip square.

- D. Upon completion of cutting and coring, clean remaining surfaces of loose particles and dust.
- E. Repair and patch all holes and openings from the removed electrical equipment, outlet boxes, etc.: Coordinate with the General Contractor and Architect to include and provide finishes to match adjacent surfaces.

1.07 PIPES, DUCTS AND CONDUITS

- A. Remove deactivated electrical conduits, including fasteners, connections, and other related appurtenances and accessories which would otherwise be exposed in the completed work or interfere with construction operations.
- B. Unless noted otherwise, remove existing exposed conduits and abandon existing concealed conduits in walls, ceilings and underground whether shown on drawings or not.
- C. Cap deactivated piping systems at point of cutoff.

1.08 **DEMOLITION DEBRIS**

- A. All demolished equipment and associated materials must be disposed of in an approved manner and in accordance with all applicable federal, state and local laws.
- B. Regularly remove debris from the site so that it's presence will not delay the progress of the work.
- C. Nothing removed from the site shall be stored, sold, or burned on site without the Owner's prior written acceptance.

1.09 RECONDITIONING EXISTING SUBSTRATES

- A. Clean surfaces on which new materials will be applied, removing adhesives, bitumen, and other adhering materials, as necessary to furnish acceptable substrates for new materials.
- B. Perform sandblasting, chipping, grinding, acid washing, etching, and other work as required by conditions encountered and new materials involved.
- C. Use of acids or other cleaning agents shall include neutralizing, washing, rinsing, and drying, as applicable.

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- D. Determine substrate requirements for reconditioned surfaces in cooperation with the manufacturer's representative and installer of each new installer involved.

1.10 DISPOSAL OF FLUORESCENT LAMPS AND BALLASTS

- A. All existing fluorescent lamps and ballasts shall be properly disposed or recycled according to the Environmental Protection Agency (EPA) and Resource Conservation and Recovery Act (RCRA) standards. Include all costs for disposal or recycling in the bid proposal.
 - 1. Lamps: Dispose or recycle through "Allied Technology Group", 47375 Fremont Blvd., Fremont, CA, 94538, (510) 490-3008 or equal.
 - 2. Ballasts: Dispose or recycle through "Fulcircle Ballast Recyclers", 550 Montori Court, Pleasanton, CA, 94556, (510) 417-5967 or equal.

1.11 ASBESTOS

- A. In the event asbestos is found to be present in areas conflicting with electrical work, before continuation of work in these areas, notify the General Contractor and/or Owner's Representative and if applicable, for the removal of such hazardous material by a certified asbestos contractor.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on field observation and existing record documents.
- D. Report discrepancies to Architect and Owner before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

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3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner Representative at least 24 hours and receive approval before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 - 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
 - 2. PCB- and DEHP-containing lighting ballasts.
 - 3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

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- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

- A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.
- C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION

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SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Scope: furnish all labor, materials, equipment, and incidentals required to install wire and cable for a complete operable electrical system as shown on the drawings and as described in the specifications.
- B. Section Includes:
 - 1. Single conductor building wire
 - 2. Metal-clad cable.
 - 3. Wire and cable for 600 volts and less.
 - 4. Wiring connectors.
 - 5. Electrical tape.
 - 6. Heat shrink tubing.
 - 7. Oxide inhibiting compound.
 - 8. Wire pulling lubricant.
 - 9. Cable ties.
 - 10. Firestop sleeves.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 00-Common Work Results for Electrical.
- C. Section 26 05 05 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

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- F. Section 28 46 00 - Fire Detection and Alarm: Fire alarm system conductors and cables.
- G. Section 31 23 16 - Excavation.
- H. Section 31 23 23 - Fill: Bedding and backfilling.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2021).
- F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation; 2018 (Reapproved 2023).
- G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
- H. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
- I. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); 2008a (Validated 2019).
- J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- K. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.
- L. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.

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- M. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- P. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- Q. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.
- R. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- S. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- T. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- U. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- V. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

- 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
- 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
- 3. Notify Electrical Engineer of Record of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials,

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construction, ratings, listings, and available sizes, configurations, and stranding.

- C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.
- D. Product Data: Provide for each cable assembly type.
- E. Test Reports: Indicate procedures and values obtained.
- F. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- G. Field Quality Control Test Reports.
- H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
- K. Project Record Documents: Record actual locations of components and circuits.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. All wire and cable shall comply with applicable standards of the Underwriters Laboratories Inc.
- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify the Electrical Engineer or Record and obtain direction before proceeding with work.

1.09 PROJECT CONDITIONS

- A. Existing Conditions
 - 1. Wire and cable routing shown on the Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.
 - 2. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.
- B. Verify that field measurements are as shown or indicated on the Drawings.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Metal-clad cable is not permitted.
- D. Manufactured wiring systems are not permitted.

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- E. Concealed Dry Interior Locations: Use only building wire in raceway.
- F. Exposed Dry Interior Locations: Use only building wire in raceway.
- G. Above Accessible Ceilings: Use only building wire in raceway.
- H. Wet or Damp Interior Locations: Use only building wire in raceway.
- I. Exterior Locations: Use only building wire with Type THWN/THW insulation in raceway.
- J. Underground Installations: Use only building wire with Type THWN/THW insulation in raceway.
- K. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- L. Use stranded conductors for control circuits.
- M. Use conductor not smaller than 12 AWG for power and lighting circuits.
- N. Use conductor not smaller than 14 AWG for control circuits.
- O. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.
- P. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 150 feet.
- Q. Conductor sizes are based on copper unless indicated as aluminum or "AL".

2.02 WIRE MANUFACTURERS (LISTED IN ALPHABETICALLY ORDER ONLY AND NOT NECESSARY BY PREFERENCE)

- A. Cerro Wire LLC
- B. General Cable.
- C. Southwire Company
- D. Stabiloy (aluminum only)
- E. United Wire and Cable
- F. Flexible cords and cables:
 - 1. Carol Cable Company
 - 2. Cerrowire

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3. PWC Corp

2.03 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide conductors and cables with lead content less than 300 parts per million.
- D. Provide new conductors and cables manufactured not more than one year prior to installation.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- F. Comply with NEMA WC 70.
- G. Comply with FS A-A-59544 where applicable.
- H. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- I. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- J. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- K. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.
- L. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.
- M. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
- N. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.

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2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 3. Tinned Copper Conductors: Comply with ASTM B33.
- O. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
 2. Control Circuits: 14 AWG.
- P. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- Q. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.

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- b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
- c. Equipment Ground, All Systems: Green.
- d. Isolated Ground, All Systems: Green with yellow stripe.
- e. Travelers for 3-Way and 4-Way Switching: Pink.
- f. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
- g. For control circuits, comply with manufacturer's recommended color code.

2.04 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

- 1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. General Cable Technologies Corporation
: www.generalcable.com/#sle.
 - c. Southwire Company: www.southwire.com/#sle.
 - d. United Wire and Cable
- 2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
 - a. Stabiloy, a brand of General Cable Technologies Corporation
: www.stabiloy.com/#sle.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

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1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.
 - a. Size 4 AWG and Larger: Type XHHW-2 or THHN/THWN.
 - b. Installed Underground: Type XHHW-2 or THHN/THWN.
 - c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.
- F. Conductor: Copper.
1. For Sizes Smaller Than 4 AWG: Copper.
 2. For Sizes 4 AWG and Larger: Copper.
- G. Insulation Voltage Rating: 600 volts.
- H. Insulation: NFPA 70, Type THHN/THWN.

2.05 METAL-CLAD CABLE

- A. Manufacturers:
1. AFC Cable Systems Inc: www.afcweb.com/#sle.
 2. Encore Wire Corporation: www.encorewire.com/#sle.
 3. Service Wire Co: www.servicewire.com/#sle.
 4. Southwire Company: www.southwire.com/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

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- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Provide oversized neutral conductors.
- G. Provide dedicated neutral conductor for each phase conductor.
- H. Grounding: Full-size integral equipment grounding conductor.
 - 1. Provide additional isolated/insulated grounding conductor.
- I. Armor: Steel, interlocked tape.
- J. Provide PVC jacket applied over cable armor.

2.06 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

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3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
 7. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - c. Blackburn-Holub.
 - d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Beau Barrier.

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- c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration with prestressed insulation to equal the insulation of wire being installed. .
- 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Thomas & Betts Corporation: www.tnb.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
- 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Thomas & Betts Corporation: www.tnb.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- K. Power Conductor Splicers
- 1. Blackburn.
 - 2. Burndy "Hylug".
 - 3. Ilso.
 - 4. O.Z. Gedney.

2.07 ACCESSORIES

A. Electrical Tape:

- 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
 - c. Or approved equal.

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

- 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.

- 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

- 4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.

- 5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.

- 6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.

- 7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
 - 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Burndy LLC: www.burndy.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

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C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

1. Manufacturers:

- a. Burndy LLC: www.burndy.com/#sle.
- b. Ideal Industries, Inc: www.idealindustries.com/#sle.
- c. IlSCO: www.ilsco.com/#sle.
- d. Or approved equal.
- e. Substitutions: See Section 01 60 00 - Product Requirements.

D. Wire Pulling Lubricant:

1. Manufacturers:

- a. 3M: www.3m.com/#sle.
- b. American Polywater Corporation: www.polywater.com/#sle.
- c. Ideal Industries, Inc: www.idealindustries.com/#sle.
- d. Or approved equal.
- e. Substitutions: See Section 01 60 00 - Product Requirements.

2. Listed and labeled as complying with UL 267.

3. Suitable for use with conductors/cables and associated insulation/jackets to be installed.

4. Suitable for use at installation temperature.

E. Cable Ties: Material and tensile strength rating suitable for application.

1. Manufacturers:

- a. Burndy LLC: www.burndy.com/#sle.
- b. Scotchflex.
- c. Thomas & Betts.
- d. Or approved equal.
- e. Substitutions: See Section 01 60 00 - Product Requirements.

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F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.

1. Products:

- a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
- b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
- c. Substitutions: See Section 01 60 00 - Product Requirements.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

1. Products:

- a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
- b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that raceway installation is complete and supported.
- E. Verify that field measurements are as indicated.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

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3.03 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
 - d. Record any circuit changes on record drawings.
8. Common Neutrals: Sharing of neutral/grounded conductors among branch circuits is not permitted.
9. Provide oversized neutral/grounded conductors where indicated and as specified below.
 - a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
 - b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.

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- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install metal-clad cable (Type MC) in accordance with NECA 120.
- E. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
 - 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
 - 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- H. Terminate cables using suitable fittings.
 - 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
 - c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.

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- I. Install conductors with a minimum of 12 inches of slack at each outlet.
- J. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- M. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
 - 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.

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- b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
- 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
- 3. Wet Locations: Use heat shrink tubing.
- O. Insulate ends of spare conductors using vinyl insulating electrical tape.
- P. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- Q. Identify conductors and cables in accordance with Section 26 05 53.
- R. Color Code Legend: Provide identification label identifying color code for ungrounded conductors at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
- S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- T. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
- U. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
- V. Route wire and cable as required to meet project conditions.
 - 1. Wire and cable routing indicated is approximate unless dimensioned.
 - 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

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3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.

W. Use wiring methods indicated.

X. Pull all conductors into raceway at same time.

Y. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

Z. Protect exposed cable from damage.

AA. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.

BB. Use suitable cable fittings and connectors.

CC. Neatly train and lace wiring inside boxes, equipment, and panelboards.

DD. Clean conductor surfaces before installing lugs and connectors.

EE. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

FF. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

GG. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

HH. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect wire for physical damage and proper connections.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's values.

D. Inspect and test in accordance with NETA ATS, except Section 4.

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- E. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
 - 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- F. Correct deficiencies and replace damaged or defective conductors and cables.
- G. Perform field inspection
- H. Megger test and record all feeder conductors.
 - 1. Replace conductors failing test.
 - 2. Test replaced conductors in same manner.

END OF SECTION

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SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Scope: provide a complete grounding and bonding system as shown on the electrical drawings and as described in the specifications such that the entire raceway system including all equipment enclosures, data racks, telephone backboards and cabinets, fixtures, and outlets, etc. are effectively connected to ground.
- B. Grounding and bonding requirements.
- C. Section includes:
 - 1. Materials and methods for grounding systems and equipment.
 - 2. Grounding electrodes and conductors.
 - 3. Equipment ground conductors.
 - 4. Bonding
 - 5. Grounding well.
 - 6. Ground bars.
 - 7. Chemically enhanced ground electrodes.
 - 8. Ground plate electrodes.
- D. Connectors for grounding and bonding.
- E. Ground bars.
- F. Ground rod electrodes.
- G. Chemically-enhanced ground electrodes.
- H. Ground plate electrodes.
- I. Ground enhancement material.
- J. Ground access wells.
- K. Pre-fabricated signal reference grids.

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- L. Provide all components necessary to complete the grounding system(s) consisting of:
 - 1. Metal underground water pipe.
 - 2. Metal frame of the building.
 - 3. Concrete-encased electrode.
 - 4. Existing metal underground gas piping system.
 - 5. Metal underground gas piping system.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 00-Common Work Results for Electrical.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
 - 1. Includes oxide inhibiting compound.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 56 00 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 99 - Health Care Facilities Code; 2021, with Amendment.
- G. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2023.

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- H. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify exact locations of underground metal water service pipe entrances to building.
2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
3. Notify Electrical Engineer of Record of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance:

1. Building grounding electrode: 10 ohms.
2. Separately Derived Sources Grounding Electrode: 10 ohms
3. Non-current carrying metal parts: 25 ohms
4. Grounds not covered above: 25 ohms

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Shop Drawings:
1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.
- D. Product Data: Provide for grounding electrodes and connections.

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- E. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Field quality control test reports.
- H. Project Record Documents: Record actual locations of grounding electrode system components and connections.
- I. Project Record Documents: Record actual locations of components and grounding electrodes.
- J. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.07 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from

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corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Electrical Engineer of Record. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- F. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.

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- b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
- c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
- 3. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
- 4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
- 5. Ground Ring:
 - a. Where indicated on drawings, provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches.
 - b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.
 - c. Provide ground enhancement material around conductor where indicated.
 - d. Provide connection from ground ring conductor to:
 - 1) Perimeter columns of metal building frame.
 - 2) Ground rod electrodes located as indicated.
 - 3) Building structural steel.
- 6. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.

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- c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - d. Provide ground enhancement material around electrode where indicated.
 - e. Provide ground access well for each electrode.
7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
8. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
- a. Ground Bar Size: 1/4 by 4 by 12 inches unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
9. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
- G. Service-Supplied System Grounding:
- 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 - 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

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H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:

1. Provide grounding electrode system for each separate building or structure.
2. Provide equipment grounding conductor routed with supply conductors.
3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

I. Separately Derived System Grounding:

1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 - b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
 - c. Generators, when neutral is switched in the transfer switch.
2. Provide grounding electrode conductor to connect derived system grounded conductor to common grounding electrode conductor ground riser. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.

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6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
 7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
- J. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.

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- c. Metal process piping.
 - 8. Provide bonding for interior metal air ducts.
 - 9. Provide bonding for metal building frame.
 - 10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
 - 11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
 - 12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.
- K. Communications Systems Grounding and Bonding:
- 1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
 - 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
- L. Pole-Mounted Luminaires: Also comply with Section 26 56 00.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

- 1. Provide products listed, classified, and labeled as suitable for the purpose intended.

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2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
 2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.
- C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 - a. Exceptions:
 - 1) Use mechanical connectors for connections to electrodes at ground access wells.
 3. Unless otherwise indicated, use mechanical connectors for accessible connections.
 - a. Exceptions:
 - 1) Use exothermic welded connections for connections to metal building frame.
 4. Manufacturers - Mechanical and Compression Connectors:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Burndy LLC: www.burndy.com/#sle.

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- c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. Thomas & Betts Corporation: www.tnb.com/#sle.
 - e. Or approved equal.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
5. Manufacturers - Exothermic Welded Connections:
- a. Burndy LLC: www.burndy.com/#sle.
 - b. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - c. Or approved equal.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Ground Bars:
- 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
 - 2. Size: As indicated.
 - 3. Holes for Connections: As indicated or as required for connections to be made.
 - 4. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Harger Lightning & Grounding: www.harger.com/#sle.
 - c. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Ground Rod Electrodes:
- 1. Comply with NEMA GR 1.
 - 2. Material: Copper-bonded (copper-clad) steel.
 - 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

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4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
 5. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Chemically-Enhanced Ground Electrodes:
1. Description: Copper tube factory-filled with electrolytic salts designed to provide a low-impedance ground in locations with high soil resistivity; straight (for vertical installations) or L-shaped (for horizontal installations) as indicated or as required.
 2. Length: 10 feet.
 3. Integral Pigtail: Factory-attached, sized not less than grounding electrode conductor to be attached.
 4. Backfill Material: Grounding enhancement material recommended by electrode manufacturer.
 5. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Harger Lightning & Grounding: www.harger.com/#sle.
 - c. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Ground Plate Electrodes:
1. Material: Copper.
 2. Size: 24 by 24 by 1/4 inches, unless otherwise indicated.

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3. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Harger Lightning & Grounding: www.harger.com/#sle.
 - c. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

- H. Ground Enhancement Material:
 1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
 2. Resistivity: Not more than 20 ohm-cm in final installed form.
 3. Manufacturers:
 - a. Harger Lightning & Grounding: www.harger.com/#sle.
 - b. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - c. Or approved equal.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

- I. Ground Access Wells:
 1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
 - a. Areas Exposed to Vehicular Traffic: Rated for not less than 2000 pounds vertical design load.
 2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
 - a. Round Wells: Not less than 8 inches in diameter.
 - b. Rectangular Wells: Not less than 12 by 12 inches.

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3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
 4. Cover: Factory-identified by permanent means with word "GROUND".
 5. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Harger Lightning & Grounding: www.harger.com/#sle.
 - c. ThermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.
 - d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- J. Oxide Inhibiting Compound: Comply with Section 26 05 19.

2.03 MANUFACTURERS

- A. Cooper Power Systems: www.cooperpower.com.
- B. Framatome Connectors International: www.fciconnect.com.
- C. Or approved equal.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ELECTRODES

- A. Manufacturers:
 1. Cooper Power Systems: www.cooperpower.com.
 2. Framatome Connectors International: www.fciconnect.com.
 3. Or approved equal.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Rod Electrodes: Copper.
 1. Diameter: 3/4 inch.
 2. Length: 10 feet.
- C. Foundation Electrodes: 3/0 AWG. unless noted on plan.

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2.05 CONNECTORS AND ACCESSORIES

- A. Mechanical Connectors: Bronze.
- B. Exothermic Connections: Weld
- C. Wire: Stranded copper.
- D. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.
- E. Grounding Well:
 - 1. Well Pipe: 8 inch by 24 inch long clay tile pipe with belled end.
 - 2. Well Cover: Cast iron with legend "GROUND" embossed on cover.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify existing conditions prior to beginning work.
- E. Verify that final backfill, and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Electrodes: Provide a grounding electrode system in the main electrical room/space of each building as follows:
 - 1. Provide a 2-inch x 1/4-inch copper ground bar. Length shall be a minimum of 12 inches but longer as required for the number of connections made to the bar. This bar shall serve as the connection point for all grounding electrodes in the building. Install the copper ground bar in a NEMA 1 screw cover cabinet, minimum size 18 inches x 12 inches x 6 inches.

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2. Connect the copper ground bar to the underground metal pipe (other than gas).
 - a. Connect to metal pipe with approved pipe clamp near the pressure reducing valve.
 - b. Connect to ground bar with exothermic weld.
 - c. Connect to metal pipe with copper clamp where copper water pipe occurs and with a malleable iron clamp where cast iron pipe occurs.
 - d. Install grounding conductor, sized as indicated on plans, in a 3/4-inch metal conduit from the ground cabinet to the water pipe. Provide grounding bushings at each end of the conduit.

3. Connect the copper ground bar to the metal frame of the building.
 - a. At all steel framed buildings, provide a connection to the closest column.
 - b. Connect to column with exothermic weld.
 - c. Connect to the ground bar with exothermic weld or bolted-type connector.
 - d. Install grounding conductor, sized as indicated on the plans, in a 3/4-inch metal conduit from the ground cabinet to the column. Provide grounding bushing at each end of the conduit.

4. Connect the copper ground bar to a concrete-encased electrode/Ufer.
 - a. Install a minimum of 20 feet of #3/0 AWG conductor (minimum unless noted otherwise) encased in a minimum of 3 inches of concrete. Provide a non-metallic protective sleeve, minimum 6 inches long (3 inches in the concrete and 3 inches out of the concrete), located where the conductor exits the concrete.
 - b. Install a #3/0 conductor from the ground bar to the concrete-encased electrode in a 3/4-inch metal conduit with grounding bushings. Make connections to the concrete-encased electrode with a bolted-type connector and transition from the metal conduit and non-metallic sleeve.
 - c. Connect to the ground bar with exothermic weld or bolted-type connector.

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5. Provide additional ground rod or concrete-encased electrodes as required to meet the performance requirements listed in these specifications at the ground bar.
 - a. Install additional ground rods a minimum of 5 feet from any other rod.
 - b. Notify the Owner's Representative if performance requirements have not been met after installing 2 additional ground rods or concrete-encased electrodes.
 6. Install other grounding electrodes as indicated on the single line diagram and other Contract Documents.
- D. Grounding Electrode Conductor
1. Install grounding electrode conductor from the main normal and emergency power panels and each separately derived system in the building to the ground bar (grounding electrode system). Install grounding electrode conductor in steel conduit and bond grounding conductor to conduit at entrance and exit. Connect to the ground bar (grounding electrode system) with exothermic weld.
 - a. Unless otherwise indicated, install main ground unspliced.
 - b. Make connections easily accessible for inspection in ground bar cabinet.
 2. Grounding electrode conductor shall be of the same type and quality as other conductors in the building.
 3. The main neutral to ground bonding jumper will be located at the site utilities switchboard. Locate additional neutral to ground bonding jumper at separately derived systems only, or at the main service panel when the building is served from a dedicated transformer. Neutral bar with all interior secondary neutrals shall be isolated from the common equipment grounding bus at all other locations.
- E. Bonding
1. Provide bonding to meet requirements of CEC.
 2. Bond together metal siding not attached to grounded structure, bond to ground.
 3. Bond prefabricated metal building to grounding electrode system at a minimum of one location.

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4. Bond together all metallic conduit, boxes, cabinets, and enclosures.

F. Grounding Conductors

1. Provide grounding conductor for each branch circuit indicated.
2. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder circuit raceway and within each motor feeder raceway. Terminate each end on suitable lug, bus, or bushing.
3. Provide separate, isolated grounding conductor for each circuit which is installed (all or in part) in non-metallic conduit.
4. Provide separate grounding conductor for circuits installed in flexible steel conduit. Terminate each end on a suitable lug, bus or bushing.
5. Ground all conduit systems, cabinets, equipment, motor frames, etc., in accordance with CEC and applicable codes.

G. Grounding Connections

1. Ground shields of shielded power cable and signal cable at each splice or termination in accordance with recommendations of the splice or termination manufacturer.
2. Ground metal sheathing and exposed metal vertical structural elements of buildings. Ground metal fences enclosing electrical equipment. Bond any metal equipment platforms which support electrical equipment to that equipment. Provide good electrical contact between metal frames and railings supporting pushbutton stations, receptacles, instrument cabinets, etc., and raceways carrying circuits to these devices.
3. Ground all fencing as shown on the grounding details on the Drawings.
4. Bond neutrals of transformers within buildings to the system ground network, and to additional indicated grounding electrodes.
5. Unless shown otherwise, make connections of grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection point below finished grade.
6. Make connections of sections of outdoor ground mats (counterpoise) for substations or other equipment underground. Make connections of other grounding conductors generally accessible.

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7. In manhole pull boxes, install ground rods with ends 4 to 6 inches above the floor with connections of grounding conductors fully visible and accessible.
 8. When making thermite welds, wire brush or file the point of contact to a bare metal surface. Use thermite welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly clean the joint. Re-galvanize area if required. For compression connectors, use homogeneous copper, anti-corrosion, surface treatment compound at connectors in accordance with connector manufacturer's recommendations. Use connectors of proper size for conductors and ground rods specified. Use connector manufacturer's compression tool. Notify the Owner's Representative prior to backfilling any ground connections.
 9. Grounding pad plates shall be cast into the slab with the surface flush with the finished floor.
- H. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
 2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
 3. Provide ground well for future access to rod electrodes.
- I. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.
- J. Make grounding and bonding connections using specified connectors.
1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.

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3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- K. Identify grounding and bonding system components in accordance with Section 26 05 53.
- L. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- M. Provide grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.
- N. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing . Bond steel together.
- O. Provide bonding to meet requirements described in Quality Assurance.
- P. Provide isolated grounding conductor for circuits supplying electronic cash registers and other similar electronic equipment loads. .
- Q. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Site Tests:
 1. Test under provisions of Section 26 08 13.
 2. Notify the Owner's Representative five days before inspection and testing.

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3. Use suitable test instruments to measure resistance to ground of systems. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.
 4. Remove main bonding jumper at main service switchboard and at each separately derived system and test for infinite resistance between neutral and ground systems. Reconnect bonding jumper(s) after completion of testing.
 5. Record test results in accordance with Section 26 05 00 and submit.
- E. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
 - G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 05 26

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SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 26 05 00 – Common Work Results for Electrical.
- D. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- E. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- F. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
- G. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- H. Section 26 56 00 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.

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- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. MFMA-4 - Metal Framing Standards Publication; 2004.
- G. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2009.
- H. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2006
- I. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2010
- J. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2009.
- K. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.
- O. UL 2239- Hardware for the Supports of Conduit, Tubing and Cable.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.

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5. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 30 00.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.
 1. Fiberglass Channel/Strut Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Design Data
 1. Indicate hanger and support framing and attachment methods.
 2. Submit seismic and structural calculations for proposed methods of support and attachment.
- E. Derating Calculations for Fiberglass Channel/Strut Framing Systems: Indicate load ratings adjusted for applicable service conditions.
- F. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
- G. Installer's qualification statement.
- H. Product Data: Provide manufacturer's catalog data for fastening systems.
- I. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- J. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

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1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at project site one copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Field Welding: See Section 05 50 00.
- D. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- E. All materials, equipment and parts comprising the units specified herein shall be new, unused, and currently under production.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Applicable building code.
 - c. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
 - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 25%.

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Include consideration for vibration, equipment operation, and shock loads where applicable.

5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Components for Vibration Isolation and/or Seismic Controls: See Section 26 05 48.
- C. Materials for Metal Fabricated Supports: See Section 05 50 00.
- D. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - e. nVent; Caddy: www.nvent.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.

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3. Conduit Clamps: Bolted type unless otherwise indicated.
- E. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- F. Metal Channel/Strut Framing Systems:
 1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 2. Comply with MFMA-4.
 3. Channel/Strut Used as Raceway, Where Indicated: Listed and labeled as complying with UL 5B.
 4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
 6. Minimum Channel Dimensions: 1-5/8 inch width by 1-5/8 inch height.
- G. Fiberglass Channel/Strut Framing Systems:
 1. Description: Factory-fabricated, continuous-slot, fiberglass channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 2. Channel Material: Use polyester resin or vinyl ester resin.
 3. Minimum Channel Dimensions: 1-5/8 inch wide by 1 inch high.
 4. Flammability: Fire retardant with NFPA 101, Class A flame spread index, maximum of 25, when tested in accordance with ASTM E84; self extinguishing in accordance with ASTM D635.
- H. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2-inch diameter.
 - b. Busway Supports: 1/2-inch diameter.

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- c. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
 - d. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
 - e. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
 - f. Outlet Boxes: 1/4-inch diameter.
 - g. Luminaires: 1/4-inch diameter.
- I. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
- 1. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
 - 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- J. Anchors and Fasteners:
- 1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 4. Hollow Masonry: Use toggle bolts.
 - 5. Hollow Stud Walls: Use toggle bolts.
 - 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 - 7. Sheet Metal: Use sheet metal screws.
 - 8. Wood: Use wood screws.
 - 9. Hammer-driven anchors and fasteners are not permitted.

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- a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
 - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.
10. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
- a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.
 - d. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
11. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

2.02 MANUFACTURERS (LISTED IN ALPHABETICALLY ORDER ONLY AND NOT NECESSARY BY PREFERENCE)

- A. Thomas & Betts Corporation: www.tnb.com.
- B. Threaded Rod Company: www.threadedrod.com.
- C. Or Approved Equal.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 SUPPORTS

- A. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, or shall be springable wrought steel. Rings shall be bolted to or interlocked with the suspension rod socket.
- B. Pipe racks for groups of parallel conduits shall be constructed of galvanized structural steel preformed channels of length as required, suspended on threaded rods and secured thereto with nuts above and below the cross bar.
- C. Factory made pipe straps shall be one hole malleable iron or two hole galvanized clamps.

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- D. Supporting rods shall be at least 3/8" diameter and channel shall be at least 3/4" deep. Supporting hardware shall be galvanized steel.

2.04 MATERIALS

- A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Supports: Fabricated of structural steel or formed steel members; galvanized.
- C. Anchors and Fasteners:
 - 1. Sheet Metal Screws: Steel
 - 2. Machine Screws Bolts, Nuts and Washers: Steel
 - 3. Precast Inserts: Suitable for the purpose.
 - 4. Anchor Bolts, expansion type (stainless steel).
 - a. Phillips Red-Head
 - b. Hilti Kwik-Bolt.
 - c. WEJ-IT.
 - 5. Cast-in-Place Anchors: Suitable for the purpose (hot-dip galvanized except cadmium plated in dry locations)
 - 6. Beam Clamps: Steel.
- D. Concrete Structural Elements: Use precast inserts, expansion anchors, or preset inserts.
- E. Steel Structural Elements: Use beam clamps or welded fasteners.
- F. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
- G. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
- H. Solid Masonry Walls: Use expansion anchors or preset inserts.
- I. Sheet Metal: Use sheet metal screws.
- J. Wood Elements: Use wood screws.

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K. Fastener Types:

1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
5. Other Types: As required.
6. Manufacturers:
 - a. Powers Fasteners, Inc: www.powers.com.
 - b. Or approved equal.

L. Formed Steel Channel as indicated on drawings.

M. Steel Spring Clips: As indicated on drawings

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. General

1. Install products in accordance with manufacturer's instructions.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

B. Install hangers and supports in accordance with NECA 1.

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

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1. Concrete – Precast inserts, cast-place anchors, or expansion type anchor bolts.
 - a. When installing drilled-in anchors in non-prestresses reinforced concrete, avoid the reinforcing bars.
 - b. When installing drilled-in anchors into prestressed concrete (Pre- or Post-tensioned) locate tendons by using a non-destructive method prior to installation. Maintain a minimum clearance of one-inch between the reinforcement and the drilled-in anchor.
2. Sheet Metal – Sheet metal screws or machine bolts, nuts, and washers.
3. Structural Steel Members – Beam clamps, machine screws, bolts, nuts, and washers.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by LP Consulting Engineers, Inc., do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Provide required vibration isolation and/or seismic controls; see Section 26 05 48.
- I. Field Welding, Where Approved by LP Consulting Engineers, Inc.: See Section 05 50 00.
- J. Equipment Support and Attachment:
 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

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4. Unless otherwise indicated, mount floor-mounted equipment on properly sized concrete pad 3 inches in height; see Section 03 30 00.
 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
 6. Install surface mounted cabinets and panelboards with minimum of four anchors.
 7. In wet and damp locations, use steel channel supports to stand cabinets and panelboards 13/16-inch minimum off wall.
 8. Use sheet metal channels to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
 9. Support equipment in accordance with manufacturer's instructions.
 10. Verify that equipment will fit support layouts indicated.
 - a. Where suitable equipment is used, revise indicated supports to fit at no additional cost.
 11. Arrange for necessary openings to allow entry of equipment.
 - a. Where equipment cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, or other devices to allow for later installation.
- K. Conduit Support and Attachment
1. In damp or wet locations, space conduit support directly from concrete or metal structure out at least ¼ inch using straps with spacers or, if three (3) or more conduits are located in a parallel run, they shall be spaced out from the wall approximately 5/8 inch to 1 inch by means of a channel.
 2. Runs of individual conduit suspended from the floor or ceiling shall be supported with pipe hangers. Where three (3) or more conduits are suspended from the floor or ceiling, suitable racks shall be constructed from channel material with suitable fittings.
 3. Space supporting points no greater than required by CEC.
- L. Sleeves
1. Set sleeves in position in formwork. Provide reinforcing around sleeves.

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2. Extend sleeves through floors 1 inch above finished floor levels. Caulk sleeves full depth and provide floor plate.
 3. Where raceway penetrated floor, ceiling, or wall. Close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal.
- M. Conduit Support and Attachment: See Section 26 05 33.13 for additional requirements.
- N. Box Support and Attachment: See Section 26 05 33.16 for additional requirements.
- O. Busway Support and Attachment: See Section 26 25 13 for additional requirements.
- P. Interior Luminaire Support and Attachment: See Section 26 51 00 for additional requirements.
- Q. Exterior Luminaire Support and Attachment: See Section 26 56 00 for additional requirements.
- R. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- S. Secure fasteners in accordance with manufacturer's recommended torque settings.
- T. Remove temporary supports.
- U. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

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1. Obtain permission from the Architect and the Structural Engineer before drilling or cutting structural members.
- E. All expansion anchors shall have 50 percent of the bolts (alternate bolts in any group arrangement) proof tested in tension and certified by a recognized testing agency at the values indicated in the following table, except where shown otherwise in the Contract Documents. If there are any failures, the immediately adjacent bolts must then also be tested. Anchor capacities shall not exceed 80 percent of the values in the published ICBO report.

ANCHOR CAPACITY (3,000 PSI MINIMUM STONE AGGREGATE CONCRETE)							
	1/2 inch	5/8 inch	3/4 inch	7/8 inch	1 inch	1-1/4 inches	UNITS
IN TENSION	680	960	1,360	1,900	2,700	3,600	LBS
IN SHEAR	1,170	1,680	2,420	3,500	5,020	6,700	LBS
TYPE OF TEST:							
DIRECT PULL-TENSION, LBS.	1,360	1,920	2,720	3,800	5,400	7,200	LBS
MINIMUM EMBEDMENT	3	3-3/4	4-1/2	5-1/4	6	7-1/2	INCHES

END OF SECTION 26 05 29

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SECTION 26 05 33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Scope: Provide rigid metallic conduit, rigid non-metallic conduit, intermediate metal conduit, flexible metal conduit, electrical metallic tubing, surface metal and/or non-metallic raceways, cable tray and wireways as shown on the drawings and as described in the specifications.

1.02 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Galvanized steel intermediate metal conduit (IMC).
- C. PVC-coated galvanized steel rigid metal conduit (RMC).
- D. Flexible metal conduit (FMC).
- E. Liquidtight flexible metal conduit (LFMC).
- F. Galvanized steel electrical metallic tubing (EMT).
- G. Rigid polyvinyl chloride (PVC) conduit.
- H. Conduit, fittings and conduit bodies.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 07 84 00 - Firestopping.
- C. Section 26 05 00 – Common Work Results for Electrical.
- D. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Cable assemblies consisting of conductors protected by integral metal armor.
- E. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- F. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- G. Section 26 05 33.16 - Boxes for Electrical Systems.
- H. Section 26 05 33.23 - Surface Raceways for Electrical Systems.

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- I. Section 26 05 39 - Underfloor Raceways for Electrical Systems.
- J. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
- K. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- L. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- M. Section 26 27 23 - Indoor Service Poles.
- N. Section 27 05 33.13 - Conduit for Communications Systems.
- O. Section 31 23 16 - Excavation.
- P. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- Q. Section 31 23 23 - Fill: Bedding and backfilling.
- R. Section 33 71 19 - Electrical Underground Ducts, Ductbanks, and Manholes.
- S. The requirements of the kitchen equipment consultant plans and specifications.

1.04 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. ANSI C80.5; Rigid Aluminum Conduit.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.

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- J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- L. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- O. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- P. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- Q. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- R. UL 635 - Insulating Bushings.
- S. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- T. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- U. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- V. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
- W. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.
- X. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

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1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
 5. Notify Electrical Engineer of Record of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Shop Drawings:
 1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
 2. Include proposed locations of roof penetrations and proposed methods for sealing.
- D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.
- E. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, fittings, and conduit bodies.
- F. Project Record Documents: Accurately record actual routing of conduits larger than 1 1/4 inches.

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- G. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

1.07 QUALITY ASSURANCE

- A. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.
- B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

1.09 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on drawings.
- B. Verify conduit routing and termination locations of conduits prior to rough in.
- C. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring systems.

1.10 RATED WALLS AND CEILINGS

- A. Inspect architectural plans for locations and fire ratings for all walls, ceilings, and floors. Install materials as required to maintain the fire integrity of the rated assemblies.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

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- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
1. Under Slab on Grade: Use rigid PVC conduit.
 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 3. Exterior, Embedded Within Concrete: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit where emerging from underground.
 5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use PVC-coated galvanized steel rigid metal conduit elbows for bends.
 6. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.
- D. Embedded Within Concrete:
1. Within Slab on Grade: Use PVC-coated galvanized steel rigid metal conduit (RMC) or rigid PVC conduit. Embed within structural slabs only where approved by Structural Engineer.
 2. Within Slab Above Ground: Use PVC-coated galvanized steel rigid metal conduit (RMC) or rigid PVC conduit. Embed within structural slabs only where approved by Structural Engineer.
 3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit or rigid PVC conduit.

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4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit where emerging from concrete.
5. Where galvanized steel electrical metallic tubing (EMT) emerges from concrete into salt air, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal

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conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
 - b. Where exposed below 20 feet in warehouse areas.
 - c. In Correctional Facilities, Galvanized rigid steel only for inmate accessible areas. Locations shall be verified with the architect.

- K. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

- L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

- M. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit.

- N. Hazardous/Classified Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit (RMC).

- O. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 1. Maximum Length: 6 feet.

- P. Flexible Connections to Vibrating Equipment:
 1. Dry Locations: Use flexible metal conduit (FMC).
 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 3. Maximum Length: 6 feet unless otherwise indicated.

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4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
 - c. Engine generators.

- Q. Fished in Existing Walls, Where Necessary: Use flexible metal conduit.

- R. Freezer and Refrigeration Rooms
 1. Galvanized rigid steel conduit.
 2. Use sealing fittings on refrigeration and freezer room conduit runs in accordance with CEC 300-7(a).

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.

- B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.

- C. Electrical Service Conduits: See Section 26 21 00 for additional requirements.

- D. Fittings for Grounding and Bonding: See Section 26 05 26 for additional requirements.

- E. Provide conduit, fittings, supports, and accessories required for complete raceway system.

- F. Provide products listed, classified, and labeled as suitable for purpose intended.

- G. Minimum Conduit Size, Unless Otherwise Indicated:
 1. Branch Circuits: 1/2-inch trade size.
 2. Branch Circuit Homeruns: 3/4-inch trade size.
 3. Control Circuits: 1/2-inch trade size.
 4. Flexible Connections to Luminaires: 1/2 inch (16 mm) trade size.
 5. Underground, Interior: 1 inch (27 mm) trade size.
 6. Underground, Exterior: 1-inch trade size.

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- H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. Allied Tube & Conduit, a division of Atkore International : www.alliedeg.com/#sle.
2. Nucor Tubular Products: www.nucortubular.com/#sle.
3. Rymco USA: www.rymcousa.com/#sle.
4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
6. Or approved equal.
7. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:

1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - b. Appleton.
 - c. Crouse-Hinds.
 - d. Emerson Electric Co; O-Z/Geaney: www.emerson.com/#sle.
 - e. Thomas & Betts Corp.
 - f. Spring City Electrical Manufacturing Co.
 - g. Or approved equal.
 - h. Substitutions: See Section 01 60 00 - Product Requirements.
2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.

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3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
 4. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 5. Connectors and Couplings: Where an expansion type fitting is not required, use a coupling or "Erickson" type coupling as appropriate. Threadless set screw and compression (gland) type fittings are not permitted.
 6. At building expansion joints, use expansion type fittings.
 7. Make connections to NEMA 12 boxes with a threaded hub.
- D. Locknuts
1. Hardened Steel or malleable iron construction, electro zinc plated, capable of insuring positive bond to enclosure.
 - a. Non-bonding: T & B Series 142 or approved equal.
 - b. Bonding: T & B Series 107 or approved equal.
- E. Bushings
1. Insulted: T & B Series 223 or approved equal.
 2. Insulated Metallic Bushing: T & B Series 1223 or approved equal.
 3. Insulated Grounding and Bonding Bushing: T & B Series 3871 or approved equal.
- F. Couplings
1. Non-metallic Conduit Coupling: By non-metallic conduit manufacturer for the application.
 2. Threaded Rigid Metal Conduit Couplings: By conduit manufacturer for the application.
 3. Threadless Coupling: "Erickson" Type Y & B Series 676 or approved equal.
 4. Expansion Type: Permit $\frac{3}{4}$ inch movement any direction.
 - a. Exposed: Weatherproof with external bonding jumper.

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b. Embedded: Watertight with internal bonding jumper.

G. Connectors

1. Non-Metallic Conduit Connector: By conduit manufacturer for the application.
2. Threaded Hubs: Electro zinc coated with nylon insulated throat and oil/moisture resistant recessed sealing ring, raintight.
 - a. Non-bonding: T & B Series 371 or approved equal.
 - b. Bonding: T & B Series 371 with 107 series bonding locknut or approved equals.

H. Nipple: "Chase" Type, insulated: T & B Series 5263 or approved equal.

I. Sealing Gaskets: Oil and moisture resistant rubber bonded to metallic retainer.

1. With rigid conduit – T & B Series 5303 or approved equal.
2. Fittings not specifically listed but required shall be of similar style and quality.

2.04 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:

1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
2. Nucor Tubular Products: www.nucortubular.com/#sle.
3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
5. Or approved equal.
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:

1. Manufacturers:

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- a. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - b. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - c. Or approved equal.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
 3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
 4. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 5. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.
- D. Conduit Size: Comply with NFPA 70.
1. Exposed: Use rigid steel conduit or intermediate metal conduit for installation up to 8 feet.

2.05 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
 2. Electri-Flex Company: www.electriflex.com/#sle.
 3. International Metal Hose: www.metalhose.com/#sle.
 4. Or approved equal.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- C. Fittings:
1. Manufacturers:

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- a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
- a. Do not use die cast zinc fittings.
- D. Description: Interlocked steel construction.
- E. Connectors and Fittings: NEMA FB 1.
1. Flexible metal conduit connector – Insulated throat, suitable as grounding means: T & B Series 3115.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
 2. Electri-Flex Company: www.electriflex.com/#sle.
 3. International Metal Hose: www.metalhose.com/#sle.
 4. Or approved equal.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.

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- d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
- D. Description: Interlocked steel construction with PVC jacket.
- E. Fittings: NEMA FB 1.

2.07 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

- 1. Allied Tube & Conduit: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular/#sle.
 - 3. Rymco USA: www.rymcousa.com/#sle.
 - 4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 5. Beck Manufacturing, Inc: www.beckmfg.com.
 - 6. Wheatland Tube Company: www.wheatland.com/#sle.
 - 7. Or Equal.
 - 8. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:

- 1. Manufacturers:
 - a. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - b. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - c. Or approved equal.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

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2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 4. Connectors and Couplings: Use compression/gland type.
 - a. Do not use indenter type connectors and couplings.
 - b. Do not use set-screw type connectors and couplings.
 - c. EMT Coupling: Raintight T & B Series 5220 or approved equal.
 - d. EMT to Rigid Metal Conduit Connector, Raintight: T & B Series 531 or approved equal.
 5. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.
 6. Embedded Within Concrete, Where Permitted: Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.
- D. Description: ANSI C80.3; galvanized tubing.
- E. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron compression type.

2.08 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
1. Cantex Inc: www.cantexinc.com/#sle.
 2. JM Eagle: www.jmeagle.com/#sle.
 3. Or approved equal.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:

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1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.09 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.
- E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
 1. Internal to fittings
 - a. Approved by manufacturer for application.
 2. Manufacturer
 - a. Crouse-Hinds Chico A-P and Chico X fiber.
 - b. O.Z. Gedney.
 - c. Or approved equal.
- F. Sealing Systems for Concrete Penetrations:
 1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
 2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.
- G. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

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1. Products:
 - a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
 - b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
 - c. Or approved equal.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

- H. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
 1. Products:
 - a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
 - b. Or approved equal.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

- I. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 1. Products:
 - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
 - b. Or approved equal.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

- J. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.
 1. Products:
 - a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.
 - b. Or approved equal.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

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- K. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for casing and conduit/duct arrangement to be installed.
1. Products:
 - a. Advance Products & Systems, LLC; Bore Spacers: www.apsonline.com/#sle.
 - b. Or approved equal.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify routing and termination locations of conduit prior to rough-in.
- E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.
- D. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.
- E. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.
- F. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.
- G. Liquidtight Flexible Nonmetallic Conduit (LFNC): Install in accordance with NECA 111.
- H. Conduit Routing:

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1. Unless dimensioned, conduit routing indicated is diagrammatic.
2. When conduit destination is indicated without specific routing, determine exact routing required.
3. Conceal conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
5. Unless otherwise approved, do not route exposed conduits:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
9. Arrange conduit to provide no more than 150 feet between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:

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- a. Heaters.
 - b. Hot water piping.
 - c. Flues.
14. Group parallel conduits in same area on common rack.
- I. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 05 29.
 2. Provide required vibration isolation and/or seismic controls; see Section 26 05 48.
 3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 5. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 6. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 8. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
 9. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
 10. Use of spring steel conduit clips for support of conduits is not permitted.
 11. Use of wire for support of conduits is not permitted.
 12. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

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J. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
8. Secure joints and connections to provide mechanical strength and electrical continuity.

K. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

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7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
 8. Provide metal escutcheon plates for conduit penetrations exposed to public view.
 9. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 84 00.
- L. Underground Installation:
1. Provide trenching and backfilling; see Section 31 23 16 and Section 31 23 23.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 18 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
 3. Provide underground warning tape along entire conduit length for service entrance where not concrete-encased; see Section 26 05 53.
- M. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Maximum Conduit Size: 1-inch trade size unless otherwise approved.
 2. Minimum Conduit Spacing: As indicated on drawings.
 3. Install conduits within middle one third of slab thickness.
 4. Secure conduits to prevent floating or movement during pouring of concrete.
- N. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide minimum concrete cover of 3 inches on all sides unless otherwise indicated; see Section 03 30 00.
- O. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.

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2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
 4. Where conduits are subject to earth movement by settlement or frost.
- P. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 - a. Where conduits enter building from outside.
 - b. Where service conduits enter building from underground distribution system.
 - c. Where conduits enter building from underground.
 - d. Where conduits may transport moisture to contact live parts.
 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- Q. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- R. Provide grounding and bonding; see Section 26 05 26.
- S. Identify conduits; see Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

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- C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- D. Correct deficiencies and replace damaged or defective conduits.

3.04 EMPTY CONDUITS

- A. Certain conduits will have no conductors pulled in as a part of this contract. Identify with tags at each end of the origin and destination of each such empty conduits. Provide a permanent cap over each end of each empty conduit. Provide a nylon pull wire in each empty conduit, tie off at both ends.

3.05 TESTING AND INSPECTION

- A. So not cover up conduit work until inspected. Notify the Owner's Representative at least 3 days before desired inspection date.

3.06 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.07 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.
- B. All conduits shall be run concealed in walls and/or ceiling. Where conduits can not be run concealed in wall and/or ceiling space, the Contractor shall coordinate with the architectural and structural plans and the Architect for installing and routing of exposed conduits.

3.08 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

END OF SECTION 26 05 33.13

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SECTION 26 05 33.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Scope: Provide boxes, pull boxes, racks, and enclosures as shown on drawings or as required by code(s).
- B. Section Includes:
 - 1. Boxes and enclosures for integrated power, data, and audio/video.
 - 2. Boxes for hazardous (classified) locations.
 - 3. Floor boxes.
 - 4. Underground boxes/enclosures.
 - 5. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 07 84 00 - Firestopping.
- C. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- E. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- F. Section 26 05 33.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- G. Section 26 05 33.23 - Surface Raceways for Electrical Systems:
 - 1. Accessory boxes designed specifically for surface raceway systems.
 - 2. Lay-in wireways and wiring troughs with removable covers.
- H. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

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- I. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- J. Section 26 27 26 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.
 - 3. Poke-through assemblies.
 - 4. Access floor boxes.
 - 5. Additional requirements for locating boxes for wiring devices.
- K. Section 26 28 13 - Fuses: Spare fuse cabinets.
- L. Section 27 10 00 - Structured Cabling: Additional requirements for communications systems outlet boxes.
- M. Section 33 71 19 - Electrical Underground Ducts, Ductbanks, and Manholes: Concrete manholes for electrical systems.
- N. The requirements of the kitchen equipment consultant plans and specifications.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013 (Reaffirmed 2020).
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.

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- J. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- L. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- M. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- N. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
- O. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- P. UL 1773 - Termination Boxes.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

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1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
 - 1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.
- C. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
- D. Samples:
 - 1. Floor Boxes: Provide one sample(s) of each floor box proposed for substitution upon request.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
6. Use suitable concrete type boxes where flush-mounted in concrete.
7. Use suitable masonry type boxes where flush-mounted in masonry walls.

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8. Use raised covers suitable for the type of wall construction and device configuration where required.
9. Use shallow boxes where required by the type of wall construction.
10. Do not use "through-wall" boxes designed for access from both sides of wall.
11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
16. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
 - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
17. Wall Plates: Comply with Section 26 27 26.
18. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Circle AW Products.
 - c. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
 - d. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.

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- e. Legrand
 - f. O-Z/Gedney, a brand of Emerson Electric Co
: www.emerson.com/#sle.
 - g. Raco, Inc.
 - h. Raceway Components, Inc.
 - i. Spring City Electrical Manufacturing Co.
 - j. Thomas & Betts Corporation: www.tnb.com/#sle.
 - k. Or equal.
 - l. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
- 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 - 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 - c. Kitchens and food prep. Locations: Type 4X, stainless steel, unpainted.
 - 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
 - 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.

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- c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.

- 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

- 6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton
Corporation: www.cooperindustries.com/#sle.

 - b. Hoffman, a brand of Pentair Technical
Products: www.hoffmanonline.com/#sle.

 - c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.

 - d. Or equal.

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

- D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.
 - 1. Manufacturers:
 - a. Hubbell Incorporated: www.hubbell.com/#sle.

 - b. Or approved equal.

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

- E. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 1. Manufacturers:
 - a. Appleton, a brand of Emerson Electric Co: www.emerson.com/#sle.

 - b. Cooper Crouse-Hinds, a division of Eaton
Corporation: www.cooperindustries.com/#sle.

 - c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com/#sle.

 - d. Or approved equal.

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

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F. Floor Boxes:

1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 27 26; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use cast iron floor boxes within slab on grade.
3. Use sheet-steel or cast iron floor boxes within slab above grade.
4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
5. Manufacturer: Same as manufacturer of floor box service fittings.

G. Underground Boxes/Enclosures:

1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Provide logo on cover to indicate type of service.
5. Applications:
 - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
 - b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
 - c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
 - a. Manufacturers:

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- 1) Hubbell Incorporated; Quazite
Products: www.hubbellpowersystems.com/#sle.
 - 2) MacLean Highline: www.macleanhigline.com/#sle.
 - 3) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
 - 4) Or equal.
 - 5) Substitutions: See Section 01 60 00 - Product Requirements.
- b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.
- c. Product(s):
- 1) MacLean Highline PHA Series: Straight wall, all-polymer concrete splice box/pull box; available Tier 8, Tier 15, and Tier 22 load ratings.
 - (a) 11 by 18 by 12 inches nominal; Model PHA111812 (stackable).
 - 2) MacLean Highline CHA Series: Fiberglass/polymer concrete splice box/pull box; available Tier 8 and Tier 15 load ratings.
 - (a) 11 by 18 by 12 inches nominal; Model CHA111812.
 - 3) MacLean Highline CVA Series: Fiberglass/polymer concrete splice vault; available Tier 8, Tier 15, and Tier 22 load ratings.
 - (a) 30 by 48 by 18 inches nominal; Model CVA304818.
 - 4) Or approved equal.

2.02 ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.

1. Manufacturers:

- a. Quickflash Weatherproofing Products,
Inc: www.quickflashproducts.com/#sle.
- b. Or approved equal.
- c. Substitutions: See Section 01 60 00 - Product Requirements.

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2.03 MANUFACTURERS

- A. Appleton Electric: www.appletonelec.com.
- B. Arc-Co./Division of Arcade Technology: www.arc-co.com.
- C. Unity Manufacturing: www.unitymfg.com.
- D. Or approved equal.
- E. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- C. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- D. 4-inch square by 2-1/4-inch deep shall be minimum box size.
- E. ANSI/NEMA OS 1.

2.05 FLOOR BOXES

- A. Floor Boxes: NEMA OS 1, fully adjustable, 1-1/2 inches deep.
- B. Material: Cast metal.
- C. Shape: Round.
- D. Service Fittings: As specified in Section 26 27 26.

2.06 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 26 27 16.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron.

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2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

- D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
 1. Material: Galvanized cast iron.
 2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
 3. Cover Legend: "ELECTRIC".

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Boxes are indicated in approximate locations only on the drawings unless specifically dimensioned. Verify all box locations prior to rough-in.
- C. Verify that mounting surfaces are ready to receive boxes.
- D. Verify that conditions are satisfactory for installation prior to starting work.
- E. Verify locations of floor boxes and outlets prior to rough-in.
- F. Verify locations of all boxes required for kitchen equipment with kitchen consultant plans and specifications.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

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G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:

1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
2. Unless dimensioned, box locations indicated are approximate.
3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
 - b. Communications Systems Outlets: Comply with Section 27 10 00.
4. Locate boxes so that wall plates do not span different building finishes.
5. Locate boxes so that wall plates do not cross masonry joints.
6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.

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10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.
 11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- I. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide required seismic controls in accordance with Section 26 05 48.
 3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

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3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
- M. Install boxes as required to preserve insulation integrity.
- N. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- O. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.
- P. Underground Boxes/Enclosures:
 1. Install enclosure on gravel base, minimum 6 inches deep.
 2. Flush-mount enclosures located in concrete or paved areas.
 3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
 4. Provide cast-in-place concrete collar constructed in accordance with Section 03 30 00, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
 5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- Q. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- S. Close unused box openings.
- T. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- U. Provide grounding and bonding in accordance with Section 26 05 26.
- V. Identify boxes in accordance with Section 26 05 53.
- W. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.

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- X. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 72.
- Y. Coordinate installation of outlet boxes for equipment connected under Section 26 27 17.
- Z. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- AA. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
 - 1. Adjust box locations up to 10 feet if required to accommodate intended purpose.
- BB. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- CC. Maintain headroom and present neat mechanical appearance.
- DD. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- EE. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- FF. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- GG. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- HH. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- II. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- JJ. Use flush mounting outlet box in finished areas.
- KK. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- LL. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in fire-rated and acoustic rated walls.

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- MM. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- NN. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- OO. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- PP. Use adjustable steel channel fasteners for hung ceiling outlet box.
- QQ. Do not fasten boxes to ceiling support wires.
- RR. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- SS. Use gang box where more than one device is mounted together. Do not use sectional box.
- TT. Use gang box with plaster ring for single device outlets.
- UU. Use cast outlet box in exterior locations exposed to the weather and wet locations.
- VV. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
- WW. Set floor boxes level.
- XX. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 ADJUSTING

- A. Adjust floor boxes flush with finish flooring material.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused box openings.

3.04 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.05 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 05 33.16

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SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.
- H. Field-painted identification of conduit.
- I. Panelboard directories.
- J. Buried electrical line warnings.
- K. Junction box identification.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 13 - Exterior Painting.
- B. Section 09 91 23 - Interior Painting.
- C. Section 26 05 00 – Common Work Results for Electrical.
- D. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- E. Section 26 05 73 - Power System Studies: Arc flash hazard warning labels.
- F. Section 26 27 26 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.
- G. Section 27 10 00 - Structured Cabling: Identification for communications cabling and devices.

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1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011 (Reaffirmed 2017).
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011 (Reaffirmed 2017).
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
- D. Samples:
 - 1. Identification Nameplates: One of each type and color specified.
 - 2. Warning Signs and Labels: One of each type and legend specified.

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- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Conform to requirements of NFPA 70.
- C. Furnish products listed and classified by UL as suitable for the purpose specified and shown.

1.07 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Switchboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use identification nameplate to identify main overcurrent protective device.
 - 5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

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- b. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

- c. Transformers:
 - 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify load(s) served. Include location when not within sight of equipment.

- d. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.

- e. Time Switches:
 - 1) Identify load(s) served and associated circuits controlled. Include location.

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- f. Enclosed Contactors:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
 - 4) Identify coil voltage.
 - 5) Identify load(s) and associated circuits controlled. Include location.

 - g. Centralized Emergency Lighting Inverters:
 - 1) Identify input and output voltage and phase.
 - 2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location.

 - h. Transfer Switches:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - 4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.

 - i. Electricity Meters:
 - 1) Identify load(s) metered.
2. Service Equipment:
- a. Use identification nameplate to identify each service disconnecting means.

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- b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
3. Emergency System Equipment:
 - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
 - c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
5. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
6. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
7. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
8. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
9. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
10. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".

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11. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
 - a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 09 91 23 and 09 91 13.
12. Available Fault Current Documentation: Comply with Section 26 05 73. Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 - b. Industrial control panels.
 - c. Motor control centers.
 - d. Elevator control panels.
 - e. Industrial machinery.
13. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.
14. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
15. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
16. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
17. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

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C. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
2. Identification for Communications Conductors and Cables: Comply with Section 27 10 00.
3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
6. Use underground warning tape to identify direct buried cables.

D. Identification for Raceways:

1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
2. Use voltage markers, color-coded bands, or factory-painted conduits to identify systems other than normal power system for accessible conduits.
 - a. Maximum Intervals: 20 feet.
 - b. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
 - 1) Field-Painting: Comply with Section 09 91 23 and 09 91 13.
 - 2) Vinyl Color Coding Electrical Tape: Comply with Section 26 05 19.

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3) Other Owner required color coding systems.

3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
 4. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
 5. Use underground warning tape to identify underground raceways.
 6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.
- E. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
 2. Use voltage markers or color coded boxes to identify systems other than normal power system.
 3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.. Install on back side of box cover.
 - a. For exposed boxes in public areas, use only identification labels.
 4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
- F. Identification for Devices:
1. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
 2. Factory Pre-Marked Wallplates: Comply with Section 26 27 26.
 3. Use identification label to identify fire alarm system devices.
 - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
 4. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.

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- a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.

- 5. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

- 6. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

- G. Identification for Luminaires:
 - 1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

- H. Buried Electrical Lines: Underground warning tapes.

- I. Communication Cabinets: Nameplates.

- J. Conduit: Conduit markers.

- K. Control Device Station: Labels.

- L. Electrical Distribution and Control Equipment Enclosures: Nameplates.

2.02 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Seton Identification Products: www.seton.com/aec.
- C. HellermannTyton: www.hellermanntyton.com.
- D. E-Z Code by T&B.
- E. Pan-Code by Panduit.
- F. Or approved equal.
- G. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 - 1. Manufacturers:

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- a. Brimar Industries, Inc: www.brimar.com/#sle.
 - b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - c. Seton Identification Products: www.seton.com/#sle.
 - d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
2. Materials:
- a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
- a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
1. Manufacturers:
 - a. Brady Corporation: www.bradyid.com/#sle.
 - b. Brother International Corporation: www.brother-usa.com/#sle.
 - c. Panduit Corp: www.panduit.com/#sle.
 - d. Or approved equal.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

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2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
 2. Legend:
 - a. System designation where applicable:
 - 1) Emergency Power System: Identify with text "EMERGENCY".
 - b. Equipment designation or other approved description.
 - c. Other information as indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height:
 - a. System Designation: 1/2 inch.
 - b. Equipment Designation: 1/4 inch.
 - c. Other Information: 1/8 inch.
 - d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
 5. Color:
 - a. Normal Power System: White text on black background.
 - 1) 480Y/277 V, 3 Phase Equipment: White text on orange background.
 - 2) 208Y/120 V, 3 Phase Equipment: White text on black background.
 - b. Emergency Power System: White text on red background.
- D. Format for General Information and Operating Instructions:

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1. Minimum Size: 1 inch by 2.5 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/4 inch.
 5. Color: Black text on white background unless otherwise indicated.
 - a. Exceptions:
 - 1) Provide white text on red background for general information or operational instructions for emergency systems.
 - 2) Provide white text on red background for general information or operational instructions for fire alarm systems.
 - 3) Provide white text on black background for all other systems, unless noted otherwise.
- E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch.
 5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Power source and circuit number or other designation indicated.
 - a. Include voltage and phase for other than 120 V, single phase circuits.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.

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G. Format for Control Device Identification:

1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

H. Manufacturers:

1. Kolbi Pipe Marker Co.; Model: www.kolbipipemarkers.com.
2. Seton Identification Product; Model: www.seton.com.
3. Or approved equal.

I. Nameplates: Engraved three-layer laminated plastic, white letters on black background, unless noted otherwise on drawings or specifications.

J. Locations:

1. Each electrical distribution and control equipment enclosure.
2. Communication cabinets.

K. Letter Size:

1. Use 1/8 inch letters for identifying individual equipment and loads.
2. Use 1/4 inch letters for identifying grouped equipment and loads.

L. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations.

2.04 WIRE AND CABLE MARKERS

A. Manufacturers:

1. Brady Corporation: www.bradyid.com/#sle.
2. Seton Identification Products: www.seton.com.
3. HellermannTyton: www.hellermanntyton.com/#sle.

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4. Panduit Corp: www.panduit.com/#sle.
 5. Or approved equal.
 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, or plastic sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
1. Do not use handwritten text.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.
- H. Description: Vinyl cloth type self-adhesive wire markers.
- I. Description: Cloth type wire markers.
- J. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.
- K. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings.

2.05 VOLTAGE MARKERS

- A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
 2. Brimar Industries, Inc: www.brimar.com/#sle.
 3. Seton Identification Products: www.seton.com/#sle.

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4. HellermannTyton: www.hellermanntyton.com.
 5. Or approved equal.
 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- D. Minimum Size:
1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- E. Legend:
1. Markers for Voltage Identification: Highest voltage present.
 2. Markers for System Identification:
 - a. Emergency Power System: Text "EMERGENCY".
 - b. Other Systems: Type of service.
- F. Color: Black text on orange background unless otherwise indicated.
- G. Location: Furnish markers for each conduit longer than 6 feet.
- H. Spacing: 20 feet on center.
- I. Color:
1. Fire Alarm System: Red.

2.06 UNDERGROUND WARNING TAPE

- A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.

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2. Brimar Industries, Inc: www.brimar.com/#sle.
 3. Seton Identification Products: www.seton.com/#sle.
 4. HellermannTyton: www.hellermanntyton.com.
 5. Or approve equal.
 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- D. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- E. Legend: Type of service, continuously repeated over full length of tape.
- F. Color:
1. Tape for Buried Power Lines: Black text on red background.
 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.07 FLOOR MARKING TAPE

- A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
 2. Brimar Industries, Inc: www.brimar.com/#sle.
 3. Insite Solutions, LLC: www.stop-painting.com/#sle.
 4. Seton Identification Products: www.seton.com/#sle.
 5. Or approved equal..
 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches wide, with alternating black and white stripes.

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2.08 WARNING SIGNS AND LABELS

A. Manufacturers:

1. Brimar Industries, Inc: www.brimar.com/#sle.
2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
3. Insite Solutions, LLC: www.stop-painting.com/#sle.
4. Seton Identification Products: www.seton.com/#sle.
5. Or approved equal.
6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:

1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
3. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:

1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - a. Do not use labels designed to be completed using handwritten text.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

E. Floor Signs:

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1. Materials: Use factory preprinted, self-adhesive vinyl, polyester, or rubber labels with protective overlaminates; removable.
 2. Minimum Size: 17-inch diameter unless otherwise indicated.
- F. Description: 3 inch wide polyethylene tape, detectable type colored red with suitable warning legend describing buried electrical lines.
- G. Description: 4 inch wide plastic tape, detectable type colored red with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.
- B. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 1. Surface-Mounted Equipment: Enclosure front.
 2. Flush-Mounted Equipment: Enclosure front.
 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 4. Elevated Equipment: Legible from the floor or working platform.
 5. Branch Devices: Adjacent to device.
 6. Interior Components: Legible from the point of access.
 7. Conduits: Legible from the floor.
 8. Boxes: Outside face of cover.
 9. Conductors and Cables: Legible from the point of access.
 10. Devices: Outside face of cover.

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- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
 - 1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 05 53

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SECTION 26 05 83 - WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 33.13 - Conduit for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 27 26 - Wiring Devices.
- F. Section 26 28 16.16 - Enclosed Switches.
- G. Section 26 29 13 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

- 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- 2. Determine connection locations and requirements.

B. Sequencing:

- 1. Install rough-in of electrical connections before installation of equipment is required.
- 2. Make electrical connections before required start-up of equipment.

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1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Comply with NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
 - 4. Product: As noted on drawings or as required for the application.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Disconnect Switches: As described and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 33.13.
- E. Wire and Cable: As specified in Section 26 05 19.

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F. Boxes: As specified in Section 26 05 33.16.

2.02 EQUIPMENT CONNECTIONS

A. Connection Types and Ratings::

1. Electrical Connection: Flexible conduit, metallic or liquid tight flexible conduit as required by the application.
2. Electrical Connection: Cord and plug (Verify NEMA configuration and rating with equipment installer at jobsite).
3. Provide field-installed disconnect switch.
4. Voltage: Verify with equipment nameplate.
5. Load rating: Verify with equipment nameplate.
6. FLA: Verify with equipment nameplate.
7. WSA: Verify with equipment nameplate.
8. Branch Circuit: Verify with equipment nameplate.
9. Location: As indicated on drawings. Verify with equipment installer at jobsite.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Contractor shall thoroughly examine Project site conditions for acceptance of wire and cable installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.
- B. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

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- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.
- J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.
- K. Bolted pressure connectors: Provide wide range-taking connectors with cast bronze compression bolts, designed for parallel taps, tees, crosses or end-to-end connections.
- L. Electrical spring wire connectors:
 - 1. Provide multi-part construction incorporating a non-restricted, zinc coated square cross-section steel spring enclosed in a steel sheet with an outer jacket of plastic and insulating skirt.
 - 2. Self-striping pigtail and tap U-contact connectors shall not be used.
- M. Compression type terminating lugs:
 - 1. Provide tin-plated copper high-compression type lugs for installation with hand or hydraulically operated circumference-crimping tools and dies as stipulated by the lug Manufacturer or as indicated on Drawings. Notch or single point type crimping is NOT acceptable.
 - 2. Two-hole, long barrel lugs shall be provided for size #4/0 and larger wire where terminated to bus bars. Use minimum of three crimps per lug, on sizes where possible.
- N. Splicing and insulating tape: Provide black, ultraviolet proof, self-extinguishing, 7-mil thick vinyl general purpose electrical tape with a dielectric strength of 10,000volts suitable for temperatures from minus 18-degrees C to 105-degrees C.
- O. Insulating putty:

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1. Provide pads or rolls of non-corrosive, self-fusing, one-eighth inch thick rubber putty with PVC backing sheet. Scotch vinyl mastic pads and roll or equal.
 2. Use putty suitable for temperatures from minus 17.8-degrees C to 37.8-degrees C with a dielectric strength of 570volts/mil minimum.
- P. Insulating resin:
1. Provide two-part liquid epoxy resin with resin and catalyst in pre-measured, sealed mixing pouch. Scotchcast 4 or equal for wet or underground vaults, boxes, etc. splices or terminations.
 2. Use resin with a set up time of approximately 30-minutes at 21.1-degrees C and with thermal and dielectric properties equal to the insulating properties of the cables immersed in the resin.
- Q. Terminal strips:
1. Provide box type terminal strips in the required quantity plus 25% spare. Install in continuous rows in terminal cabinets.
 2. Use the box type terminal strips with barrier open backs and with ampere ratings as required.
 3. Identify all terminals with numbering sequence being used for a system.
- R. Crimp type connectors:
1. Provide insulated fork or ring crimp terminals with tinned electrolytic copper-brazed barrel with funnel wire entry and insulation support
 2. Fasten crimp type connectors or terminals using a crimping tool recommended by the connector Manufacturer.
 3. Provide insulated overlap splices with tinned seamless electrolytic copper barrel with funnel wire entry and insulation support.
 4. Provide insulated butt splices with tinned seamless electrolytic copper barrel with center stop, funnel wire entry and insulation support.
- S. Cable ties: Provide harnessing and point-to-point wire bundling with nylon cable ties. All cable ties shall be installed using tool supplied by Manufacturer of ties.
- T. Wire lubricating compound:

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1. UL listed for the wire insulation and conduit type and shall not harden or become adhesive.
 2. Shall not be used on wire for isolated type electrical power systems.
- U. Bolt termination hardware:
1. Bolts shall be plated, medium carbon steel heat-treated, quenched and tempered equal to ASTM A-325 or SAE grade 5; or silicon bronze alloy ASTM B-9954 Type B.
 2. Nuts shall be heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B steel or silicon bronze alloy.
 3. Flat washers shall be steel or silicon bronze, Type A plain standard wide series, confirming to ANSI B27.2. SAE or narrow series shall not be used.
 4. Belleville conical spring washers shall be hardened steel, cadmium plated or silicon bronze.
 5. Each bolt connecting lug(s) to a terminal or bus shall not carry current exceeding the following values:
 - a. 1/4" bolt: 125amps
 - b. 5/16" bolt: 175amps
 - c. 3/8" bolt: 225amps
 - d. 1/2" bolt: 300amps
 - e. 5/8" bolt: 375amps
 - f. 3/4" bolt: 450amps

END OF SECTION

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SECTION 26 08 00 - ELECTRICAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The purpose of this section is to specify the Contractor's responsibilities and participation in the commissioning process relative to division 26.
- B. The commissioning process is primarily the responsibility of the Commissioning Authority, with support for start-up, testing, and commissioning the responsibility of the Contractors. The commissioning process does not relieve the Contractor from participation in the process, or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner.
- C. Work of Division 26 includes:
 - 1. Testing and start-up of the electrical equipment.
 - 2. Providing qualified personnel to assist in commissioning tests to verify equipment/ system performance.
 - 3. Completion and endorsement of pre-functional test checklists provided by the Commissioning Authority to assure that Division 26 equipment and systems are fully operational and ready for functional testing.
 - 4. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
 - 5. Providing training for the systems specified in Division 26 with coordination of owner by the Commissioning Authority.

1.02 RELATED WORK

- A. All testing and start-up procedures and documentation requirements specified within Division 26.
- B. Section 01 9100 - General Commissioning Requirements
- C. Commissioning functional test procedures that require participation of the Contractors.
- D. Cooperate with the Commissioning Authority in the following manner:

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1. Allow sufficient time before final completion dates so that testing can be accomplished.
2. Provide labor and material to make corrections when required without undue delay.
3. Coordinate all required support of that equipment which is provided to or installed with involvement of Division 23 contractors.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. Standard certified test equipment for commissioning shall be provided by the Division 26 Contractor.
- B. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Authority in the commissioning process.

PART 3 - EXECUTION

3.01 WORK PRIOR TO COMMISSIONING

- A. Complete all phases of work so the system can be started, tested, balanced, and otherwise commissioned. Division 26 has temporary power and start-up responsibilities with obligations to complete systems, including all sub-systems so they are functional. This includes the complete installation of all equipment and materials per the contract documents and related directives, clarifications, change orders, etc.
- B. The Commissioning Authority will develop a Commissioning Plan. Upon request of the Commissioning Authority, the Contractor shall provide assistance and consultation. The Commissioning Plan will be developed prior to completion of the installation. The Contractor is obligated to assist the Commissioning Authority in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation.
- C. Specific pre-commissioning responsibilities of Division 26 are as follows:
 1. Normal start-up services required to bring each system into a fully operational state. The Commissioning Authority will not begin the commissioning process until each system is complete and documented, including normal contractor start-up.

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2. The Contractor shall perform pre-functional tests on the equipment and systems as noted in section 01 9100 General Commissioning Requirements.
 3. Contractor start-up forms may be substituted for the pre-functional test forms with prior approval by the Commissioning Authority.
 4. Pre-functional test forms will be kept in the Contractors job trailer in a Commissioning Field Notebook provided by the Commissioning Authority.
 5. Factory start-up services will be provided for key equipment and systems specified in Division 26. The Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.
- D. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and/or sub-systems, if expediting this work is in the best interests of the Owner. Commissioning activities and schedule will be coordinated with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems as per the schedule.
- E. The Field Commissioning Notebook will be used to identify and track all pertinent commissioning documentation required during the Installation phase. This Notebook will be assembled by the Commissioning Authority and maintained by the Contractor. The Notebook provides a central location for the Commissioning Authority to identify, copy and organize all pertinent information and will include the following format:
1. Summary describing Notebook contents and use.
 2. Copy of Commissioning Plan for contractor field reference.
 3. Listing of all specification documentation requirements listed by specification section, with sign off spots for appropriate contractors.
 4. Tabs for each specification section with copies of pre-functional test check sheets provided by coordination of subcontractors and Commissioning Authority for contractor completion and space for related contractor-supplied documents.
 5. Prior to functional testing the Commissioning Authority will use this book to verify that all appropriate contractors have completed their work and signed off that they have done so. Once the Commissioning Authority is satisfied that all components of a system are complete functional testing will begin.

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3.02 PARTICIPATION IN COMMISSIONING

- A. Provide skilled technicians to start up and debug all systems within the division of work. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.

3.03 WORK TO RESOLVE DEFICIENCIES

- A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet the original design intent. Correction of work will be completed under the direction of the Architect, with input from the Contractor, equipment supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Architect/Engineer of Record will have final jurisdiction on the necessary work to be done to achieve performance and or design intent.

3.04 ADDITIONAL COMMISSIONING

- A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor, suppliers, and Commissioning Authority shall include a reasonable reserve to complete this work as part of their standard contractual obligations.

3.05 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

- A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the

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spring and fall. Initial commissioning will be done as soon as contract work is completed regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

- B. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. The Contractor will be responsible to participate in the initial and the alternate peak season test of the systems required to demonstrate performance.
- C. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. The Contractor will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

3.06 TRAINING

- A. The Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each mechanical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.
- B. Training will be conducted jointly with the Commissioning Authority, the design engineers, the equipment vendors, and the Contractor. The Contractor will be responsible for the generic training, as well as instructing the Owner's staff on the system peculiarities specific to this project.

3.07 SYSTEMS DOCUMENTATION

- A. Contract Documents to incorporate field changes and revisions to system designs to account for actual constructed configurations will be addressed as required in Division 1. All drawings should be red-lined on two sets. Division 26 as-built drawings should include updated architectural floor plans, and the individual electrical systems in relation to actual building layout.
- B. Maintain as-built red-lines on the job site as required in Division 1.
- C. In addition to the stated requirements for operation and maintenance data, provide one copy of equipment technical literature, operation and maintenance literature, and shop drawings to the Commissioning Authority as soon as they

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are available. This requirement is for review of these documents prior to distribution of multiple copies for the Owner's final use.

END OF SECTION 26 08 00

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SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Outdoor motion sensors.
- C. Time switches.
- D. In-wall time switches.
- E. In-wall interval timers.
- F. Outdoor photo controls.
- G. Daylighting controls.
- H. Lighting contactors.
- I. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 09 18 - Remote Control Switching Devices: Remotely controlled devices for lighting control, including networked lighting controls, programmable relay panels, and remote-control switching relays.
- F. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
 - 1. Includes finish requirements for wall controls specified in this section.
 - 2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.
- G. Section 26 28 13 - Fuses.
- H. Section 26 51 00 - Interior Lighting.

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I. Section 26 56 00 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.
- C. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2020.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- E. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- H. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- I. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2017.
- J. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
- M. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
- N. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- O. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.
- P. UL 924 Standard for emergency lighting and power equipment.

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- Q. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- R. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.
- S. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
5. Notify the Architect and/or the Electrical Engineer of Record of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install lighting control devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

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1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
 2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
- D. Samples:
1. Occupancy Sensors: One for each type and color specified.
 2. In-Wall Time Switches: One for each type and color specified.
 3. In-Wall Interval Timers: One for each type and color specified.
 4. Daylighting Control Photo Sensors: One for each type and color specified.
- E. Field Quality Control Reports.
- F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Operation and Maintenance Data: Include detailed information on device programming and setup.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Extra Locking Receptacle-Mounted Outdoor Photo Controls: Five percent of total quantity installed for each type, but not less than two of each type.
 3. Electronic Trip Circuit Breakers: Provide one portable test set.
 4. Indicating Lights: Two of each different type.
- I. Project Record Documents: Record actual installed locations and settings for lighting control devices.

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1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all occupancy sensors.
- C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.
- D. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. General Requirements
 - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.

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2. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
3. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.02 OCCUPANCY SENSORS

A. Manufacturers:

1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
2. Douglas "Dialog".
3. ETC "Echo".
4. Eaton "Greengate Room Controller".
5. Hubbell Incorporated: www.hubbell.com/#sle.
6. Intermatic, Inc: www.intermatic.com/#sle.
7. Legrand North America, Inc: www.legrand.us/#sle.
8. Lutron Electronics Company, Inc: www.lutron.com/#sle.
9. RAB Lighting, Inc: www.rablighting.com/#sle.
10. Or approved equal..
11. Substitutions: See Section 01 60 00 - Product Requirements.
12. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
13. Wattstopper "DLM".

B. All Occupancy Sensors:

1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.

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- b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
 - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 - d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 8. Sensitivity: Field adjustable.
 9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 10. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
 11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.

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12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
 13. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
 14. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
 15. Wireless Sensors:
 - a. RF Range: 30 feet through typical construction materials.
 - b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
 - c. Power: Battery-operated with minimum ten-year battery life.
- C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
 - c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
 - d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - f. Provide selectable audible alert to notify occupant of impending load turn-off.

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- g. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
 - h. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.
- 2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
 - 3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 400 square feet.
 - 4. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- D. Wall Dimmer Occupancy Sensors:
- 1. General Requirements:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.
 - b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
 - e. Provide field adjustable dimming preset for occupied state.
 - f. Provide fade-to-off operation to notify occupant of impending load turn-off.
 - g. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.

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2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- E. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - e. Finish: White unless otherwise indicated.
 2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 3. Ultrasonic Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Medium Range Sensors: Capable of detecting motion within an area of 1,000 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - c. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet at a mounting height of 9 feet.
 4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:

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- a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
- a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.
- F. Directional Occupancy Sensors:
1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
 - a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - b. Provide field selectable setting for disabling LED motion detector visual indicator.
 - c. Finish: White unless otherwise indicated.
 2. Passive Infrared (PIR) Directional Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
 - b. Long Range Sensors: Capable of detecting motion within a distance of 80 feet at a mounting height of 10 feet.
 - c. High Bay Sensors: Capable of detecting motion within a distance of 50 feet at a mounting height of 30 feet.
 3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.

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- G. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.
1. Fluorescent High Bay Luminaire Mounted Occupancy Sensors: Passive infrared (PIR) type with a field of view of 360 degrees unless otherwise indicated.
 - a. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
 - b. Finish: White unless otherwise indicated.
 - c. Circular Coverage Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 20 feet.
 - d. Linear Aisle Coverage Sensors: Capable of detecting motion within an area of 20 feet wide by 60 feet long at a mounting height of 40 feet.
 - e. Accessories:
 - 1) Provide mounting bracket for lowering occupancy sensor such that luminaire does not block sensor field of view where required.
- H. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 4. Load Rating: As required to control the load indicated on drawings.
- I. Power Packs for Wireless Occupancy Sensors:
1. Description: Plenum rated; self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
 2. Input Supply Voltage: Dual rated for 120/277 V ac.
 3. Load Rating: As required to control the load indicated on drawings.
 4. Provide auxiliary contact closure output where indicated.

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5. Rated Life of Relay: One million cycles.

J. Accessories:

1. Provide heavy duty coated steel wire protective guards compatible with specified occupancy sensors where indicated on plans.

K. OUTDOOR MOTION SENSORS

1. Manufacturers:

- a. Acuity Brands, Inc: www.acuitybrands.com/#sle.
- b. Hubbell Lighting, Inc: www.hubbellighting.com/#sle.
- c. Legrand North America, Inc: www.legrand.us/#sle.
- d. RAB Lighting, Inc: www.rablighting.com/#sle.
- e. Or approved equal.
- f. Substitutions: See Section 01 60 00 - Product Requirements.
- g. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.

3. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.

4. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.

5. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.

6. Integral Photocell: For dusk to dawn operation.

7. Manual Override: Activated by switching power off to unit and then back on.

8. Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.

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9. Coverage: Capable of detecting motion within a distance of 50 feet at a mounting height of 8 feet, with a field of view of 270 degrees.
10. Finish: Color to be selected by architect.
11. Provide integral lamp holders suitable for two 150 watt PAR 38 lamps.

L. TIME SWITCHES

1. Manufacturers:
 - a. Intermatic, Inc: www.intermatic.com/#sle.
 - b. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
 - c. Or approved equal.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
2. Digital Electronic Time Switches:
 - a. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
 - b. Program Capability:
 - 1) 24-Hour Time Switches: Single channel, with same schedule for each day of the week and skip-a-day feature to omit selected days.
 - 2) 7-Day Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days.
 - 3) Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
 - c. Schedule Capacity: Not less than 16 programmable on/off operations.
 - d. Provide automatic daylight savings time and leap year compensation.

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- e. Provide power outage backup to retain programming and maintain clock.
 - f. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
 - g. Provide remote photocell input with light level adjustment.
 - h. Input Supply Voltage: As indicated on the drawings.
 - i. Output Switch Configuration: As required to control the load indicated on drawings.
 - j. Output Switch Contact Ratings: As required to control the load indicated on drawings.
 - k. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:
 - 1) Indoor clean, dry locations: Type 1.
 - 2) Outdoor locations: Type 3R.
 - l. Provide flush-mounted unit where indicated, where mounted in public areas, or where mounted adjacent to flush-mounted equipment.
3. Electromechanical Time Switches:
- a. Description: Factory-assembled controller with motor-operated timing dial mechanism and adjustable trippers for setting on/off operations, listed and labeled as complying with UL 917.
 - b. Program Capability:
 - 1) 24-Hour Time Switches: With same schedule for each day of the week and skip-a-day feature to omit selected days.
 - 2) 7-Day Time Switches: Capable of different schedule for each day of the week.
 - 3) Astronomic Time Switches: With same schedule for each day of the week and skip-a-day feature to omit selected days with automatic adjustment for seasonal changes in sunrise and sunset times.
 - c. Schedule Capacity:

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- 1) 24-Hour Time Switches: Accommodating not less than 12 pairs of selected on/off operations per day.
 - 2) 7-Day Time Switches: Accommodating not less than two pairs of selected on/off operations per day.
 - 3) Astronomic Time Switches: Capable of turning load on at sunset and off at either sunrise or selected fixed time.
- d. Provide spring reserve backup to maintain clock during power outage.
 - e. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
 - f. Input Supply Voltage: As indicated on the drawings.
 - g. Output Switch Configuration: As required to control the load indicated on drawings.
 - h. Output Switch Contact Ratings: As required to control the load indicated on drawings.
 - i. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:
 - 1) Indoor clean, dry locations: Type 1.
 - 2) Outdoor locations: Type 3R.
 - j. Provide flush-mounted unit where indicated, where mounted in public areas, or where mounted adjacent to flush-mounted equipment.

M. IN-WALL TIME SWITCHES

1. Manufacturers:
 - a. Intermatic, Inc: www.intermatic.com/#sle.
 - b. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
 - c. Or approved equal.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - e. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
2. Digital Electronic In-Wall Time Switches:

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- a. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.
 - b. Program Capability:
 - 1) 7-Day Time Switches: Capable of different schedule for each day of the week.
 - 2) Astronomic Time Switches: Capable of different schedule for each day of the week and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
 - c. Schedule Capacity: Not less than 40 programmable on/off operations.
 - d. Provide automatic daylight savings time compensation.
 - e. Provide power outage backup to retain programming and maintain clock.
 - f. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
 - g. Switch Configuration: Suitable for use in either SPST or 3-way application.
 - h. Contact Ratings: As required to control the load indicated on drawings.
3. Electromechanical In-Wall Time Switches:
- a. Description: Factory-assembled controller with motor-operated timing dial mechanism and adjustable trippers for setting on/off operations, suitable for mounting in standard wall box, and listed and labeled as complying with UL 917.
 - b. Program Capability: 24-hour time switch with same schedule for each day of the week.
 - c. Schedule Capacity: Accommodating not less than 24 selected on/off operations per day.
 - d. Manual override: Capable of permanently overriding current schedule.
 - e. Switch Configuration: SPST.

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- f. Contact Ratings: As required to control the load indicated on drawings.

N. IN-WALL INTERVAL TIMERS

1. Manufacturers:

- a. Intermatic, Inc: www.intermatic.com/#sle.
- b. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
- c. Or approved equal.
- d. Substitutions: See Section 01 60 00 - Product Requirements.
- e. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2. Digital Electronic In-Wall Interval Timers:

- a. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.
- b. Program Capability: Designed to turn load off at end of preset time interval.
- c. Time Interval: Field selectable range of presets available up to 12 hours.
- d. Provide field selectable audible and visual indication to warn that end of interval operation is about to turn off load.
- e. Provide power outage backup to retain programming and maintain clock.
- f. Manual override: Capable of both turning load off and resetting timer to original preset time interval.
- g. Switch Configuration: Suitable for use in either SPST or 3-way application.
- h. Contact Ratings: As required to control the load indicated on drawings.

3. Spring Wound In-Wall Interval Timers:

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- a. Description: Factory-assembled controller with mechanical spring wound timing mechanism requiring no electricity to operate; suitable for mounting in standard wall box; rotary control operator with matching wall plate factory marked with time interval units; listed and labeled as complying with UL 916 or UL 917.
- b. Program Capability: Designed to turn load off at end of preset time interval.
- c. Time Interval: User selectable from zero up to 15 minutes.
- d. Manual override: Provide hold feature to disable timer for constant on operation.
- e. Switch Configuration: SPST.
- f. Contact Ratings: As required to control the load indicated on drawings.

O. OUTDOOR PHOTO CONTROLS

1. Manufacturers:
 - a. Intermatic, Inc: www.intermatic.com/#sle.
 - b. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
2. Stem-Mounted Outdoor Photo Controls:
 - a. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
 - b. Housing: Weatherproof, impact resistant polycarbonate.
 - c. Photo Sensor: Cadmium sulfide.
 - d. Provide external sliding shield for field adjustment of light level activation.
 - e. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.

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- f. Voltage: As required to control the load indicated on the drawings.
- g. Failure Mode: Fails to the on position.
- h. Load Rating: As required to control the load indicated on the drawings.
- i. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

3. Locking Receptacle-Mounted Outdoor Photo Controls

- a. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on a compatible receptacle, listed and labeled as complying with UL 773.
- b. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
- c. Photo Sensor: Cadmium sulfide.
- d. Light Level Activation: 1 to 3 footcandles turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
- e. Voltage: As required to control the load indicated on the drawings.
- f. Failure Mode: Fails to the on position.
- g. Load Rating: As required to control the load indicated on the drawings.
- h. Surge Protection: 160 joule metal oxide varistor.
- i. Provide the following accessories where indicated or as required to complete installation:
 - 1) Receptacle: Complying with ANSI C136.10.
 - 2) Mounting Bracket.
 - 3) Shorting Cap: Suitable for replacing locking photo control to complete circuit.

4. Button Type Outdoor Photo Controls

- a. Description: Direct-wired photo control unit complying with ANSI C136.24 with weatherproof gasketed wall plate where required or indicated, listed and labeled as complying with UL 773A.

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- b. Housing: Weather resistant polycarbonate.
- c. Photo Sensor: Cadmium sulfide.
- d. Light Level Activation: 1 to 3 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
- e. Voltage: As required to control the load indicated on the drawings.
- f. Failure Mode: Fails to the on position.
- g. Load Rating: As required to control the load indicated on the drawings.

P. DAYLIGHTING CONTROLS

- 1. Manufacturers:
 - a. Hubbell Control
Solutions: www.hubbell.com/hubbellcontrolsolutions/en/#sle.
 - b. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - c. Sensor Switch Inc: www.sensorswitch.com/#sle.
 - d. WattStopper: www.wattstopper.com/#sle.
 - e. Or approved equal.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
 - g. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- 2. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.
- 3. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
 - a. Sensor Type: Filtered silicon photo diode.
 - b. Sensor Range:
 - 1) Indoor Photo Sensors: 5 to 100 footcandles.

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- 2) Outdoor Photo Sensors: 5 to 250 footcandles.
 - 3) Atrium Photo Sensors: 200 to 2,500 footcandles.
 - 4) Skylight Photo Sensors: 1,000 to 6,000 footcandles.
 - 5) Open Loop Photo Sensors: 3 to 6,000 footcandles.
- c. Finish: White unless otherwise indicated.
4. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
 5. Wireless Daylighting Control Photo Sensors:
 - a. RF Range: 30 feet through typical construction materials.
 - b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
 - c. Power: Battery-operated with minimum ten-year battery life.
 6. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.
 7. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
 - a. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
 - b. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
 - c. Control Capability:
 - 1) Single Zone Switching Modules: Capable of controlling one programmable channel.
 - 2) Multi-Zone Switching Modules: Capable of controlling up to three separately programmable channels.

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Q. Daylighting Control Switching Modules for Wireless Sensors:

1. Description: Plenum rated, self-contained relay compatible with specified wireless photo sensors for switching of line voltage loads in response to changes in measured light levels according to selected settings.
2. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
3. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
4. Control Capability: Capable of controlling one programmable channel.
5. Input Supply Voltage: Dual rated for 120/277 V ac.
6. Load Rating: As required to control the load indicated on drawings.
7. Provide auxiliary contact closure output where indicated.
8. Rated Life of Relay: One million cycles.
9. Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
 - a. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
 - b. Load to be turned off when available daylight is sufficient to fully dim the load, after the selected time delay.
 - c. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
 - d. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
 - e. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.
 - f. Output Voltage: Compatible with specified dimming ballasts.

R. Daylighting Control Dimming Modules for Wireless Sensors:

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1. Description: Plenum rated control unit compatible with specified wireless photo sensors and with specified dimming ballasts, for continuous dimming of compatible dimming ballasts in response to changes in measured light levels according to selected settings.
2. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
3. Load to be turned off when available daylight is sufficient to fully dim the load, after the selected time delay.
4. Control Capability: Capable of controlling up to 32 ballasts with up to two separately programmable daylighting zones.
5. Power Packs for Low Voltage Daylighting Control Modules:
 - a. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 - b. Input Supply Voltage: Dual rated for 120/277 V ac.
6. Load Ratings: As required to control the load indicated on drawings.
7. Accessories:
 - a. Where indicated, provide compatible accessory wall switches for manual override control.
8. Where indicated, provide compatible accessory wireless controls for manual override control.

S. LIGHTING CONTACTORS

1. Manufacturers:
 - a. ABB/GE: www.geindustrial.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Rockwell Automation Inc; Allen-Bradley Products: ab.rockwellautomation.com/#sle.

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- d. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
 - e. Siemens Industry, Inc: www.usa.siemens.com/#sle.
 - f. Or approved equal.
 - g. Substitutions: See Section 01 60 00 - Product Requirements.
2. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.
3. Combination Contactors: NEMA ICS 2, Class A combination controllers with magnetic contactor(s) and externally operable disconnect.
- a. Disconnects: Circuit breaker or disconnect switch type as indicated.
 - 1) Disconnect Switches: Fusible or nonfusible type as indicated.
 - 2) Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
 - 3) Provide auxiliary interlock for disconnection of external control power sources where applicable.
4. Short Circuit Current Rating:
- a. Provide contactors with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
5. Enclosures:
- a. Comply with NEMA ICS 6.
 - b. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 1) Indoor Clean, Dry Locations: Type 1 or Type 12.
 - 2) Outdoor Locations: Type 3R or Type 4.
 - c. Finish: Manufacturer's standard unless otherwise indicated.

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T. ACCESSORIES

1. Auxiliary Contacts:
 - a. Comply with NEMA ICS 5.
 - b. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each lighting contactor, minimum.
2. Pilot Devices:
 - a. Comply with NEMA ICS 5; heavy-duty type.
 - b. Nominal Size: 30 mm.
 - c. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
 - d. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
 - e. Indicating Lights: Push-to-test type unless otherwise indicated.
 - f. Provide LED lamp source for indicating lights and illuminated devices.
3. Control and Timing Relays:
 - a. Comply with NEMA ICS 5.
 - b. Provide number and type of relays indicated or required to perform necessary functions.
 - c. Timing Relays: Electronic or pneumatic as indicated.
 - 1) Adjustable Timing Range: As indicated on drawings.
4. Fire-Rated Device Enclosures:
 - a. Manufacturers:
 - 1) Fire Rated Product Specialties Corp: www.frpsonline.com/#sle.
 - 2) Or approved equal.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.

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- b. Provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with CEC 2007.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1, including mounting heights specified in that standard unless otherwise indicated
- C. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of lighting control devices provided under this section.
 - 1. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.

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2. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect and/or Owner's Representative to obtain direction prior to proceeding with work.
- D. Install lighting control devices in accordance with manufacturer's instructions.
- E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- F. Install lighting control devices plumb and level, and held securely in place.
- G. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 27 26.
- H. Provide required supports in accordance with Section 26 05 29.
- I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- J. Identify lighting control devices in accordance with Section 26 05 53.
- K. Occupancy Sensor Locations:
1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- L. Outdoor Photo Control Locations:
1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

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- M. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.
- N. Daylighting Control Photo Sensor Locations:
1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for proper control of respective room or area based on manufacturer's recommendations for installed devices.
 2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
 3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.
- O. Combination Enclosed Lighting Contactors:
1. Except where indicated to be mounted adjacent to the equipment they supply, mount lighting contactors such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
 2. Provide fuses complying with Section 26 28 13 for fusible switches as indicated.
- P. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- Q. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
- R. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.
- S. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

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- T. Where indicated or required, provide cabinet or enclosure in accordance with Section 26 05 33.16 for mounting of lighting control device system components.
- U. Where indicated or required, provide cabinet or enclosure in accordance with Section 26 27 16 for mounting of lighting control device system components.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test time switches to verify proper operation.
- E. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.
- G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by manufacturer.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Owner's Representative.. Record settings in written report to be included with submittals.

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- F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by LP Consulting Engineers, Inc..
- G. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Owner's Representative.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 COMMISSIONING

- A. See Section 01 91 13 - General Commissioning Requirements for commissioning requirements.

3.08 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of lighting control devices to District Representative, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's (Owner's) personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
 - 4. Location: At project site.

END OF SECTION 26 09 23

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SECTION 26 24 13 - SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Switchboards and Distribution Panel (800 amps and greater).
- B. Overcurrent protective devices for switchboards.
- C. Switchboard and Distribution Panel accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- G. Section 26 21 00 - Low-Voltage Electrical Service Entrance.
 - 1. Includes Utility Company contact information.
- H. Section 26 25 13 - Low-Voltage Busways.
- I. Section 26 28 13 - Fuses: Fuses for fusible switches.
 - 1. Includes requirements for spare fuses and spare fuse cabinets.
- J. Section 26 43 00 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

- A. ANSI C12 - Code for Electricity Metering.
- B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

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- C. IEEE C12.1 - American National Standard Code for Electricity Metering; Institute of Electrical and Electronic Engineers; 1988.
- D. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- I. NEMA AB1 - Molded Case Circuit Breakers.
- J. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
- K. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less; 2023.
- L. NEMA PB 2.2 - Application Guide Ground Fault Protective Devices for Equipment.
- M. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL 486E - Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
- P. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- Q. UL 869A - Service Equipment.
- R. UL 891 - Switchboards; Current Edition, Including All Revisions.
- S. UL 943 - Ground-Fault Circuit Interrupters.
- T. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

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1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
5. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
- D. Manufacturer's equipment seismic qualification certification.
- E. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Enclosure Keys: Two of each different key.
 3. Electronic Trip Circuit Breakers: Provide one portable test set.

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1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

1.09 WARRANTY

- A. Units and components shall be cover by a 1-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship.

1.10 EXTRA MATERIAL

- A. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Switchboards:
 - 1. ABB: www.electrification.us.abb.com/#sle.

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2. Square D.
3. Eaton Corporation: www.eaton.com/#sle.
4. Schneider Electric: www.se.com/#sle.
5. Siemens Industry, Inc: www.new.siemens.com/#sle.
6. Substitutions: See Section 01 60 00 - Product Requirements.
7. Source Limitations: Provide switchboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.02 DISTRIBUTION PANEL

- A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.
- D. Front-Connected Switchboards:
 1. Main Device(s): Individually-mounted.
 2. Feeder Devices: Panel/group-mounted.
 3. Arrangement: Front accessible only (not rear accessible), rear aligned.
 4. Gutter Access: Bolted covers.
- E. Rear-Connected Switchboards:
 1. Main Device(s): Individually-mounted.
 2. Feeder Devices: Individually-mounted.
 3. Compartmentalization: Provide barriered compartments for each overcurrent protective device, distribution bus, and rear cable connection area.
 4. Arrangement: Rear accessible, front and rear aligned.

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5. Rear Access: Bolted covers.

- F. Switchboards With Busway Transitions: Configured for bussed connection to busway provided in accordance with Section 26 25 13.

- G. Service Conditions:
 1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude: Less than 6,600 feet.
 - b. Ambient Temperature:
 - 1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.
 - 2) Switchboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.
 2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

- H. Short Circuit Current Rating:
 1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
 2. Minimum Rating: 65,000 rms symmetrical amperes.
 3. Listed series ratings are not acceptable.

- I. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

- J. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

- K. Bussing: Sized in accordance with UL 891 temperature rise requirements.
 1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
 2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.

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3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 4. Phase and Neutral Bus Material: Copper.
 5. Ground Bus Material: Copper.
- L. Conductor Terminations: Suitable for use with the conductors to be installed.
1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Main and Neutral Lug Type: Mechanical.
 2. Load Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Lug Type:
 - 1) Provide mechanical lugs.
- M. Enclosures:
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
 - b. Outdoor Locations: Type 3R.
 2. Finish: Manufacturer's standard unless otherwise indicated.
 3. Outdoor Enclosures:
 - a. Enclosure Type: Non-walk-in type unless otherwise indicated.
 - b. Color: Manufacturer's standard.
 - c. Access Doors: Lockable, with all locks keyed alike.
- N. Future Provisions:
1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

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2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.
 3. Where designated spaces for future device provisions are not indicated, include provisions for minimum of 4 device(s) rated at 225 amperes.
 4. Arrange and equip through bus and ground bus to accommodate future installation of additional switchboard sections.
- O. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00, list switchboards as a complete assembly including surge protective device.
- P. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Provide test panel and field-adjustable ground fault pick-up and delay settings.
- Q. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- R. Owner Metering:
1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
 2. Measured Parameters:
 - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
 - b. Current (Amps): For each phase and neutral.
 - c. Frequency (Hz).
 - d. Real power (kW): For each phase, 3-phase total.

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- e. Reactive power (kVAR): For each phase, 3-phase total.
 - f. Apparent power (kVA): For each phase, 3-phase total.
 - g. Power factor.
3. Meter Accuracy: Plus/minus 1.0 percent.
- S. Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated on plans.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:

1. Interrupting Capacity:

- a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
- b. Provide fully rated systems. Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
- c. Series Rated Systems are not acceptable.

2. Molded Case Circuit Breakers:

- a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
- c. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - 1) Provide the following field-adjustable trip response settings:
 - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - (b) Long time delay.
 - (c) Short time pickup and delay.

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- (d) Instantaneous pickup.
 - (e) Ground fault pickup and delay where ground fault protection is indicated.
 - d. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - 2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
- 3. Insulated Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
 - b. Construction:
 - 1) Provide fixed-mount circuit breakers unless otherwise indicated.
 - c. Trip Units: Solid state, microprocessor-based, true rms sensing.
 - 1) Provide the following field-adjustable trip response settings:
 - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - (b) Long time delay.
 - (c) Short time pickup and delay.
 - (d) Instantaneous pickup.
 - (e) Ground fault pickup and delay where ground fault protection is indicated.
 - d. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

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2.04 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
 - 1. Dielectric tests.
 - 2. Mechanical operation tests.
 - 3. Grounding of instrument transformer cases test.
 - 4. Electrical operation and control wiring tests, including polarity and sequence tests.
 - 5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive switchboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install switchboards plumb and level.

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- G. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
- H. Provide grounding and bonding in accordance with Section 26 05 26.
- I. Install all field-installed devices, components, and accessories.
- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 05 73.
- L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- M. Provide filler plates to cover unused spaces in switchboards.
- N. Identify switchboards in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- C. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
- D. Inspect and test in accordance with NETA ATS, except Section 4.
- E. Perform inspections and tests listed in NETA ATS, Section 7.1.
- F. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 100 amperes. Tests listed as optional are not required.
- G. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.

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- H. Electrical tests:
 - I. Perform resistance tests through bus joints with low-resistance ohmmeter. Joints that cannot be directly measured due to permanently installed insulation wrap shall be indirectly measured from closest accessible connection.
 - J. Perform insulation-resistance tests on each bus section, phase-to-phase, and phase-to-ground, at 1000volt DC for 60-seconds. Investigate resistance values less than 50-megohms.
 - K. Perform over-potential test on each bus section, each phase-to-ground with phases not under test grounded, in accordance with Manufacturer's published data. Test voltage shall be applied for 60-seconds.
 - L. Perform insulation-resistance tests at 1000volt DC for 60-seconds on control wiring. Do not perform this test on wiring connected to solid-state components.
 - M. Perform current injection tests on the entire current circuit in each section of switchgear.
 - N. Perform current tests by primary injection, where possible, with magnitudes such that minimum of 1amp flows in secondary circuit.
 - O. Where primary injection is impractical, utilize secondary injection with minimum current of 1amp.
 - P. Test current at each device.
 - Q. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
 - R. Test shunt trips to verify proper operation.
 - S. Correct deficiencies and replace damaged or defective switchboards or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchboard covers and doors.

3.05 CLEANING

- A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

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3.06 TRAINING

- A. Factory authorized service representative shall conduct a 4-hour training seminar for Owner's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance, and testing of equipment with both classroom training and hands-on instruction.
- B. Contractor shall schedule training with a minimum of 7-days advance notice.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchboard and associated devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.

3.08 PROTECTION

- A. Protect installed switchboards from subsequent construction operations.

END OF SECTION 26 24 13

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SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Power distribution panelboards (400amps to 800amps).
- B. Branch circuit panelboards.
- C. Lighting and appliance panelboards.
- D. Load centers.
- E. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- G. Section 26 22 00 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.
- H. Section 26 28 13 - Fuses: Fuses for fusible switches and spare fuse cabinets.
- I. Section 26 43 00 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

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- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- F. NEMA AB 1- Molded Case Circuit Breakers.
- G. NEMA PB 1 - Panelboards; 2011.
- H. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less; 2023.
- I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- M. UL 67 - Panelboards; Current Edition, Including All Revisions.
- N. UL 486E- Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
- O. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- P. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- Q. UL 870- Wireways, Auxiliary Gutters and Associated Fittings.
- R. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- S. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- T. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

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1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 4. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.

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- E. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- F. Field Quality Control Test Reports.
- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- I. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- J. Maintenance Materials: Furnish the following for Owner's (Owner's) use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Panelboard Keys: Two of each different key.
 - 3. See Section 26 28 13 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

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- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 - 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

1.09 WARRANTY

- A. Units and components shall be cover by a 1-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship.

1.10 EXTRA MATERIAL

- A. Turn over two (2) sets of panelboard keys to the Owner at completion of Project. All panelboards shall be keyed alike.
- B. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric; Square D Products
- D. Siemens Industry, Inc: www.usa.siemens.com/#sle.
- E. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

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2.02 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Seismic Qualification: Provide panelboards and associated components suitable for application under the seismic design criteria specified in Section 26 05 48 where required. Include certification of compliance with submittals.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- D. Short Circuit Current Rating:
 - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
 - 2. Listed series ratings are not acceptable, except where pre-approved by the Owner and LP Consulting Engineers, Inc.
- E. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- F. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- G. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- H. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.

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3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 4. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - c. Provide removable end walls for NEMA Type 1 enclosures.
 - d. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
 4. Lockable Doors: All locks keyed alike unless otherwise indicated. Provide door-in-door construction.
- K. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

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- L. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00, list and label panelboards as a complete assembly including surge protective device.
- M. Panelboard Contactors: Where panelboard contactors are indicated, provide electrically operated, mechanically held magnetic contactor complying with NEMA ICS 2.
 - 1. Ampere Rating: Not less than ampere rating of panelboard bus.
 - 2. Short Circuit Current Rating: Not less than the panelboard short circuit current rating.
 - 3. Coil Voltage: As required for connection to control system indicated.
- N. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 - 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
 - c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- O. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- P. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- Q. Provide the following features and accessories where indicated or where required to complete installation:

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1. Feed-through lugs.
2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 1. Main and Neutral Lug Material: Suitable for terminating aluminum or copper conductors.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 1. Phase and Neutral Bus Material: Copper.
 2. Ground Bus Material: Copper.
- D. Circuit Breakers:
 1. Provide bolt-on type.
 2. Provide thermal magnetic circuit breakers unless otherwise indicated.
 3. Provide electronic trip circuit breakers where indicated.
- E. Enclosures:
 1. Provide surface-mounted or flush-mounted enclosures unless otherwise indicated.
 2. Fronts: Provide trims to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles.
 3. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 4. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 5. Provide clear plastic circuit directory holder mounted on inside of door.

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6. Painted gray over rust inhibiting primer.
- F. Description: NEMA PB 1, circuit breaker type.
- G. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- H. Minimum integrated short circuit rating: As indicated or as required by the short circuit study.
 1. 240 Volt Panelboards: amperes rms symmetrical per plan.
 2. 480 Volt Panelboards: amperes rms symmetrical per plan.
- I. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.
- J. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay.
 1. Coil operating voltage: 120 volts, 60 Hz.
 2. Size as shown on Drawings.
- K. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- L. Enclosure: NEMA PB 1, Type 1, 6 inches deep, 20 inches wide, cabinet box.
- M. Cabinet Front: Surface type, fastened with screws, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.
- N. Nameplate: Provide factory nameplate to include the following:
 1. Manufacturer.
 2. Order number.
 3. Panelboard Type.
 4. System Voltage.
 5. Bus ampacity.
 6. Short circuit bracing rating.
 7. UL label.
 8. Service entrance label. (if applicable)

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2.04 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Suitable for terminating aluminum or copper conductors. .
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Phase and Neutral Bus Material: Copper.
 - 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
 - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 - 2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 3. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 4. Provide clear plastic circuit directory holder mounted on inside of door.
- F. Provide column-width panelboards with accessory column-width cable trough and pullbox where indicated.
- G. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard ; provide insulated ground bus where scheduled.
- H. Minimum Integrated Short Circuit Rating: As indicated or as required by the short circuit study.
 - 1. 240 Volt Panelboards: 10,000 amperes rms symmetrical.

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2. 480 Volt Panelboards: 14,000 amperes rms symmetrical.
- I. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.
 1. Type SWD for lighting circuits.
 2. Type HACR for air conditioning equipment circuits.
 3. Class A ground fault interrupter circuit breakers where scheduled.
 4. Do not use tandem circuit breakers.
- J. Enclosure: NEMA PB 1, Type 1.
- K. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards.
- L. Cabinet Front: Flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- M. Special Features:
 1. Provide blocking clips or lock-off devices on circuit breakers as indicated on the drawings.
 2. Provide barriered space for mounting contactors and control devices with a hinged door and lock, where shown or required.
 3. Provide neutral bars with terminal for all active, spare, and inactive circuits.
 4. Provide feed-thru lugs or sub-feed lugs for 2 and 3 section panels.
 5. Equip bus bars for panelboard with main lugs, main fused switch, or main circuit breaker, capacity as required or as indicated.
 6. Provide special features such as split bus, lighting contactors, extra-wide gutters as required or as indicated.
 7. Provide panels with individual branch circuit power metering where noted on plans for connections to Facility Energy Management System. Provide Square D type NFMVP, NQMVP or approved equal.

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2.05 BRANCH CIRCUIT PANELBOARDS

- A. Enclosure shall be 20" wide x 5-3/4" deep, surface or flush mounted and shall comply with NEMA PB 1.
- B. Flush panelboards mounted adjacent to each other shall be same physical size.
- C. Where "SPACE" is indicated on panelboard schedules or Drawings, install minimum 100amp branch circuit cross connectors and mounting hardware. For future device spaces larger than 100amps, cross connectors shall match the frame size ampere rated noted.

2.06 LOAD CENTERS

- A. Description: Circuit breaker type load centers listed and labeled as complying with UL 67; ratings, configurations, and features as indicated on the drawings.
 - 1. Load centers are permitted only where called for specifically on the drawings
- B. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Bus Material: Copper.
- C. Circuit Breakers: Thermal magnetic plug-in type, quantity and ratings as indicated on drawings.
- D. Enclosures:
 - 1. Provide flush-mounted enclosures unless otherwise indicated.
 - 2. Fronts: Provide cover without door to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles.
 - 3. Fronts: Provide hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 4. Provide circuit directory label on inside of door or individual circuit labels adjacent to circuit breakers.

2.07 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:

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1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Provide fully rated systems. Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated
 - c. Provide fully rated systems. Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - d. Series Rated Systems are not acceptable.
3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - a. Provide the following field-adjustable trip response settings:
 - 1) Long time pickup, adjustable by setting dial.
 - 2) Long time delay.
 - 3) Short time pickup and delay.
 - 4) Instantaneous pickup.
 - 5) Ground fault pickup and delay where ground fault protection is indicated.

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6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
8. Do not use tandem circuit breakers.
9. Provide multi-pole circuit breakers or circuit breaker handle-ties for multi-wire branch circuits as required by NFPA 70.
10. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.08 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

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- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Provide required seismic controls in accordance with Section 26 05 48.
- G. Install panelboards plumb and when recessed, flush with wall finishes. Provide all backing for equipment support. Fasten all free-standing equipment to concrete slab. Mounting bolts on floor mounted panels shall extend into pads only and shall not be in direct contact with building structural members.
- H. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- I. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 6 feet 7 inches above the floor or working platform.
- J. Mount floor-mounted power distribution panelboards on properly sized 3-inch-high concrete pad constructed in accordance with Section 03 30 00.
- K. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- L. Provide grounding and bonding in accordance with Section 26 05 26.
 - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
 - 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- M. Install all field-installed branch devices, components, and accessories.
- N. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- O. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- P. Set field-adjustable circuit breaker tripping function settings as indicated.

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- Q. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 05 73.
- R. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- S. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.
- T. Install panelboards plumb. Install recessed panelboards flush with wall finishes.
- U. Height: 6 feet 6 inches to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- V. Provide filler plates to cover unused spaces in panelboards.
- W. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
 - 1. Emergency and night lighting circuits.
 - 2. Fire detection and alarm circuits.
 - 3. Communications equipment circuits.
 - 4. Intrusion detection and access control system circuits.
 - 5. Video surveillance system circuits.
- X. Identify panelboards in accordance with Section 26 05 53.
- Y. Provide computer-generated circuit directory card for each lighting and appliance panelboard and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.
- Z. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- AA. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- BB. Provide arc flash warning labels in accordance with NFPA 70.
- CC. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.
 - 1. Minimum spare conduits: 6 empty 1 inch.

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DD. Ground and bond panelboard enclosure according to Section 26 05 26.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform field inspection and testing in accordance with Section 01 40 00.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breaker larger than 100 amperes.
- E. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- F. Electrical tests:
 - 1. Insulation resistance: 1000volt DC tests for one minute on all 600volt and lower rated equipment, components, buses, feeder and branch circuits and control circuits. Test phase-to-phase and phase-to-ground circuits showing less than 10-megohms resistance to ground shall be repaired or replaced.
 - 2. Circuit continuity: All feeders shall be tested for continuity. All neutrals shall be tested for improper grounds.
 - 3. Ground resistance: Test resistance to ground of system and equipment ground connection.
- G. In the event the system fails to function properly during the testing as a result of inadequate pretesting or preparation. The Contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence, and the Engineer's hourly rate.
- H. Contractor shall replace at no costs to the Owner all devices which are found defective or do not operate within factory specified tolerances.
- I. Contractor shall submit the Testing Agency's final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies, and remedies. Test report shall be included in the operation and maintenance manuals.

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- J. Test GFCI circuit breakers to verify proper operation.
- K. Test AFCI circuit breakers to verify proper operation.
- L. Test shunt trips to verify proper operation.
- M. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.
- N. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 24 16

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SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Fan speed controllers.
- D. Time switches.
- E. Receptacles.
- F. Wall plates and covers.
- G. Floor box service fittings.
- H. Poke-through assemblies.
- I. Access floor boxes.
- J. Occupancy sensors Occupancy/vacancy sensors, including wallbox and ceiling mounted.

1.02 RELATED REQUIREMENTS

- A. Section 09 69 00 - Access Flooring.
- B. Section 26 05 00 – Common Work Results for Electrical.
- C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- E. Section 26 05 33.16 - Boxes for Electrical Systems.
- F. Section 26 05 39 - Underfloor Raceways for Electrical Systems.
- G. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 05 83 - Wiring Connections: Cords and plugs for equipment.

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- I. Section 26 09 23 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.
- J. Section 27 10 00 - Structured Cabling: Voice and data jacks.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h, with Amendments (2017).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2014g, with Amendment (2017).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interruptioners; Current Edition, Including All Revisions.
- L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.
- M. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- N. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- O. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

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1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
6. Notify the Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 1. Wall Dimmers: Include derating information for ganged multiple devices.
 2. Surge Protection Receptacles: Include surge current rating, voltage protection rating (VPR) for each protection mode, and diagnostics information.
- C. Samples: One for each type and color of device and wall plate specified.
- D. Certificates for Surge Protection Receptacles: Manufacturer's documentation of listing for compliance with UL 1449.
- E. Field Quality Control Test Reports.

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- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Operation and Maintenance Data:
 - 1. Wall Dimmers: Include information on operation and setting of presets.
 - 2. GFCI Receptacles: Include information on status indicators.
 - 3. Surge Protection Receptacles: Include information on status indicators.
- H. Project Record Documents: Record actual installed locations of wiring devices.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
 - 3. Extra Keys for Locking Switches: Two of each type.
 - 4. Extra Surge Protection Receptacles: Two of each type.
 - 5. Extra Wall Plates: One of each style, size, and finish.
 - 6. Extra Flush Floor Service Fittings: Two of each type.
 - 7. Extra Poke-Through Core Hole Closure Plugs: Two for each core size.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.
- B. Products: Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.08 WARRANTY

- A. Occupancy sensors shall be covered by a **1**-year parts and labor warranty for malfunctions resulting from defects in materials and workmanship.

PART 2 PRODUCTS

2.01 WIRING DEVICES - GENERAL REQUIREMENTS

2.02 MANUFACTURERS

- A. Cooper Wiring Devices: www.cooperwiringdevices.com.
- B. GE Industrial: www.geindustrial.com.
- C. Leviton Manufacturing, Inc: www.leviton.com.
- D. Sensor: SensorSwitch, Inc.
- E. Pass & Seymour.
- F. Hubbell.
- G. Bryant.
- H. Legrand
- I. Arrow-Hart.
- J. Wattstopper
- K. Or approved equal.

2.03 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

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- C. Provide weather-resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations. Receptacles to be clearly identified as weather resistant as required by CEC.
- D. Provide tamper resistant receptacles for receptacles installed in dwelling units.
- E. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- F. Provide GFCI protection for receptacles installed in kitchens.
- G. Provide GFCI protection for receptacles serving electric drinking fountains.
- H. Provide isolated ground receptacles for receptacles serving computers and electronic cash registers.
- I. Unless noted otherwise, do not use combination switch/receptacle devices.
- J. For flush floor service fittings, use tile rings for installations in tile floors.
- K. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.04 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
- C. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
- D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.
- F. Isolated Ground Convenience Receptacles: Orange.
- G. Surge Protection Receptacles: Blue.
- H. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.
- I. Clock Hanger Receptacles: Brown with stainless steel wall plate.
- J. Above-Floor Service Fittings: Gray wiring devices with satin aluminum housing.
- K. Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.

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- L. Flush Poke-Through Service Fittings: Gray wiring devices with aluminum cover and aluminum flange.
- M. Access Floor Boxes: Gray wiring devices with gray steel cover with insert to match floor covering.

2.05 ALL WIRING DEVICES

~~~~~ **PROJECT NOTE** ~~~~~

Most authorities having jurisdiction with respect to electrical code enforcement accept Underwriters Laboratories listing and classification as evidence that a product meets adequate safety standards and, in the case of classification, is suitable for the classified environment or application. Many authorities also accept similar listing and classification from other testing agencies. The second choice permits other testing agencies, including Underwriters Laboratories, to provide such a determination.

~~~~ **END OF PROJECT NOTE** ~~~~

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.06 WALL SWITCHES

- A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable FS W-S-896; types as indicated on the drawings.

- 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

- B. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

- 1. Products:

- a. Single-pole: Hubbell #1221-I, Bryant #4901-GI, Pass & Seymour #20AC1-I.
- b. Double-pole: Hubbell #1222-I, Brant #4902-GI, Pass & Seymour #20AC2-I.
- c. Three-way: Hubbell #1223-I, Bryant #4903-GI, Pass & Seymour #20AC3-I.

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- d. Four-way: Hubbell #1224-I, Bryant #4904-GI, Pass & Seymour #20AC4-I.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Lighted Wall Switches: Industrial specification grade, 20 A, 120/277 V with illuminated standard toggle type switch actuator and maintained contacts; illuminated with load off; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- D. Pilot Light Wall Switches: Industrial specification grade, 20 A, 120/277 V with red illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- 1. Products:
 - a. Hubbell #1221-PLR, Bryant #4901-PLR, Pass & Seymour #20AC1-PLR.
 - b. Or approved equal.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with barrel type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- F. Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with toggle type three position switch actuator and momentary contacts; single pole double throw, off with switch actuator in center position.
- G. Locking Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed three position switch actuator and momentary contacts; switches keyed alike; single pole double throw, off with switch actuator in center position.
- H. Wall Switches: Heavy Duty, AC only general-use snap switch, complying with NEMA WD 6 and WD 1.
- 1. Body and Handle: white plastic with toggle handle.
 - 2. Indicator Light: Lighted handle type switch; red handle.
 - 3. Locator Light: Lighted handle type switch; red color handle.

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4. Ratings:
 - a. Voltage: 120 and 277 volts, AC.
 - b. Current: 20 amperes.
- I. Switch Types: Single pole, double pole, and 3-way.

2.07 WALL DIMMERS

- A. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
- B. Control: Slide control type with separate on/off switch.
- C. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:
 1. Incandescent: 600 W.
 2. Magnetic Low-Voltage: 600 VA.
 3. Electronic Low-Voltage: 400 VA.
 4. Fluorescent: 600 VA.
 5. LED: 600 VA
- D. Provide locator light, illuminated with load off.
- E. Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.
- F. Incandescent Wall Dimmers: Semiconductor dimmer for incandescent lamps, Type as indicated on drawings, complying with NEMA WD 6 and WD 1.
 1. Body and Handle: white plastic with linear slide control.
 2. Voltage: 120 and 277 volts.
 3. Power Rating: 600 watts.
- G. LED Wall Dimmers: NEMA WD 1, Type II semiconductor dimmer for LED lamps.

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1. Power rating to match load shown on the drawings.
 2. Voltage as required for controlled LED fixtures.
- H. Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.

2.08 FAN SPEED CONTROLLERS

- A. Description: 120 V AC, solid-state, full-range variable speed, slide control type with separate on/off switch, with integral radio frequency interference filtering, fan noise elimination circuitry, power failure preset memory, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1917.
1. Current Rating: 1.5 A unless otherwise indicated or required to control the load indicated on the drawings.

2.09 RECEPTACLES

- A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498 and where applicable FS W-C-596; types as indicated on the drawings.
1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 2. NEMA configurations specified are according to NEMA WD 6.
 3. Hospital Grade Receptacles: Listed as complying with UL 498 Supplement SD, with green dot hospital grade mark on device face.
- B. Convenience Receptacles:
1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
 3. Isolated Ground Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.

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4. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
 5. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
 6. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
 7. Illuminated Convenience Receptacles: Hospital grade, 20A, 125V, NEMA 5-20R; illuminated face or indicator light to indicate power is being supplied to receptacle; single or duplex as indicated on the drawings.
- C. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
 4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
 5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
- D. USB Charging Devices:

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1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
 - a. Charging Capacity - Two-Port Devices: 2.1 A, minimum.
 - b. Charging Capacity - Four-Port Devices: 4.2 A, minimum.
 2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (Type A) USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.
 3. USB Charging Noncombination Devices: Four-port (Type A); rectangular decorator style.
- E. Surge Protection Receptacles:
1. Surge Protection Receptacles - General Requirements: Listed and labeled as complying with UL 1449, Type 2 or 3.
 - a. Energy Dissipation: Not less than 240 J per mode.
 - b. Protected Modes: L-N, L-G, N-G.
 - c. UL 1449 Voltage Protection Rating (VPR): Not more than 700 V for L-N, L-G modes and 1200 V for N-G mode.
 - d. Diagnostics:
 - 1) Visual Notification: Provide indicator light to report functional status of surge protection.
 - 2) Audible Notification: Provide switchable audible alarm to report that surge protection is not functional.
 2. Standard Surge Protection Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 3. Isolated Ground Surge Protection Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, with ground contacts isolated from mounting strap.
- F. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.
1. Standard Locking Convenience Receptacles: Single, 20A, 125V, NEMA L5-20R.

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- G. Clock Hanger Receptacles: Single, 15A, 125V, NEMA 5-15R.
- H. Special Purpose Receptacle Outlet: .20A, 250V, 3 pole, 4 wire, 3 phase grounding, single: NEMA 15-20R; black (Hubbell 8420).
- I. Special Purpose Receptacle Outlet: 20A, 125/250V, 3 pole, 4 wire, 1 phase grounding, single: NEMA 14-20R; black (Hubbell 8410).
- J. Special Purpose Receptacle Outlet: 30A, 125V, 2 pole, 3 wire grounding, single; NEMA 5-30R; black (Hubbell 9308).
- K. Special Purpose Receptacle Outlet: 30A, 250V, 2 pole, 3 wire grounding, single; NEMA 6-30R; black (Hubbell 9330).
- L. Special Purpose Receptacle Outlet: 30A, 250V, 3 pole, 4 wire, 3 hose, grounding, single; NEMA 15-30R; black (Hubbell 8430A).
- M. Special Purpose Receptacle Outlet: 30A, 125/250V, 3 pole, 4 wire, 1 phase grounding, single; NEMA 14-30 R; black (Hubbell 9430A).
- N. Special Purpose Receptacle Outlet: 30A, 250V, 2 pole, 3 wire, 1 phase grounding, single, twist-lock; NEMA L6-30R; black (Hubbell 2620).
- O. Special Purpose Receptacle Outlet: 30A, 250V, 3 pole, 4 wire, 3 phase, grounding, single, twist-lock; NEMA L15-30R; black (Hubbell 2720).
- P. Special Purpose Receptacle Outlet: 50A, 250V, 2 pole, 3 wire, 1 phase, grounding, single; NEMA 6-50R; black (Hubbell 9367).
- Q. Special Purpose Receptacle Outlet: 50A, 250V, 2 pole, 3 wire, 1 phase, grounding, single, twist-lock; black (Hubbell 25505), with wall plate per NFPA 56A. Portable x-ray receptacle.
- R. Special Purpose Receptacle Outlet: 20A, 250V, 2 pole, 3 wire, 1 phase, grounding, single, twist-lock; NEMA L6-20R; black (Hubbell 2320).
- S. Special Purpose Receptacle Outlet: 50A, 125/250V, 3 pole, 4 wire, 1 phase, grounding, single; NEMA 14-50R; black (Hubbell 9450A).
- T. Special Receptacle: 20A, 4 pole, 5 wire, 3 phase Y, 120/208V; NEMA L21-20; black (Hubbell 2510).
- U. Special Receptacle: 30A, 4 pole, 5 wire, 3 phase Y, 120/208V; NEMA L21-30; black (Hubbell 2810).
- V. Special Purpose Receptacle Outlet: 15A, 125V, 2 pole, 3 wire, isolated ground, duplex; NEMA 5-15R; orange (Hubbell IG-5262).

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- W. Special Purpose Receptacle Outlet: 20A, 125V, 2 pole, 3 wire, isolated ground, duplex; NEMA 5029R; orange (Hubbell IG-5362).
- X. Special Purpose Receptacle Outlet: 30A, 125V, 2 pole, 3 wire, 1 phase, grounding, single, twist-lock; NEMA L5-30R; black (Hubbell 2610).
- Y. Special Purpose Receptacle Outlet: 20A, 125V, 2 pole, 3 wire, single, twist-lick; NEMA L5-20R; black.
- Z. Special Receptacle Outlet: 30A, 250V, 2 pole, 3 wire, 1 phase grounding, single, twist lock, isolated ground; NEMA L6-30R; orange (Hubbell IG-2620).
- AA. Special Receptacle Outlet: 30A, 4 pole, 5 wire, 3 phase Y, 277/408V; NEMA L22-30, black.
- BB. Special Receptacle Outlet: 60A, 3 pole, 4 wire, 3 phase, 480V; watertight pin and sleeve type; red, Hubbell 460R7W with BB601W 15 degree angle back box.
- CC. Special Receptacle Outlet: 60A, 277/480V, 4 pole, 5 wire, single pin and sleeve.
 - 1. Manufacturers
 - a. Appleton.
 - b. Hubbell; Model 560R7W.
 - c. Or approved equal.
- DD. Special Receptacle Outlet: 60A, 250V, 3 pole, 4 wire, 3 phase, grounding, single; NEMA 15-60R; black.
 - 1. Manufacturers
 - a. Bryant; Model 8460.
 - b. Hubbell; Model 8460A.
 - c. Pass & Seymour; Model 5760-BL.
 - d. Or approved equal.
- EE. Other receptacle types as indicated on the drawings and/or as required for connection of designated equipment.

2.10 WALL PLATES AND COVERS

- A. Wall Plates: Comply with UL 514D.

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1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
 4. Provide screwless wallplates with concealed mounting hardware where indicated.
- B. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Brass Wall Plates: Brushed satin finish, factory-coated to inhibit oxidation.
- E. Aluminum Wall Plates: Smooth satin finish, clear anodized, factory-coated to inhibit oxidation.
- F. Chrome Wall Plates: Smooth finish, chrome plated steel.
- G. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
- H. Pre-marked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.
- I. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.
- J. Weatherproof Covers for Wet or Damp Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.
- K. Weatherproof Switch Covers for Wet or Damp Locations: Gasketed, metallic, with externally operable actuating means and corrosion-resistant screws; listed as suitable for use in wet locations.
- L. Decorative Cover Plates: white, nylon, verify color with architect.
- M. Jumbo Cover Plates: white, nylon, verify color with architect.
- N. Weatherproof Cover Plates: Gasketed cast metal with hinged.
- O. Inmate Areas: In Correctional Facilities

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1. Minimum Level Device Plate: Type 430 stainless steel, flush, satin finish, approximately 20 gauge.
 - a. Hollow Metal Jamb Posts: Arrow-Hart #T-1650; Bryant, Stainless Steel.
2. Medium Level Device Plate: Stainless steel; Type 430.
3. Maximum Level Device Plate:
 - a. Back Plate: Cold rolled steel; 10 gauge, prime painted.
 - b. Cover Plate: Steel; 10 gauge, prime painted.
 - c. Fasteners: Minimum for security fasteners.
 - d. Manufacturers: Hubbell, Fail-Safe, Mark.
 - e. Cast Metal Plate for Surface Type Boxes: Corrosive resistant, cast ferrous metal, designed for the application.
 - f. Plastic Device Plates: Not permitted.
 - g. Fasteners: Tamper proof metal fasteners under provisions of Section 05 05 23.
 - h. Device Plates Installed in Housing Units: Patient Cells, Holding Cells, and Receiving Tanks shall be maximum level device plates.
 - i. Device Plates Installed In Mechanical Rooms, Electrical Rooms, Control Rooms and areas 12 feet or more above finished floor shall be minimum level device plates.
 - j. Device plates installed in other areas shall be Medium level device plates.

2.11 FLOOR BOX SERVICE FITTINGS

- A. Description: Service fittings compatible with floor boxes provided under Section 26 05 33.16 with components, adapters, and trims required for complete installation.
- B. Above-Floor Service Fittings:
 1. Single Service Pedestal Convenience Receptacles:
 - a. Configuration: One standard convenience duplex receptacle.
 2. Single Service Pedestal Communications Outlets:

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- a. Configuration: One 1 inch bushed opening.
 - b. Voice and Data Jacks: As specified in Section 27 30 00.
3. Single Service Pedestal Furniture Feed:
- a. Configuration: One 3/4 inch knockout.
4. Dual Service Pedestal Combination Outlets:
- a. Configuration:
 - 1) Power: One standard convenience duplex receptacle.
 - 2) Communications: One 1 inch bushed opening.
 - 3) Voice and Data Jacks: As specified in Section 27 30 00.
 - b. Provide barrier to separate line and low voltage compartments.
- C. Flush Floor Service Fittings:
1. Single Service Flush Convenience Receptacles:
 - a. Cover: Rectangular.
 - b. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
 2. Single Service Flush Communications Outlets:
 - a. Cover: Rectangular.
 - b. Voice and Data Jacks: As specified in Section 27 30 00.
 3. Single Service Flush Furniture Feed:
 - a. Cover: Rectangular.
 - b. Configuration: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
 4. Dual Service Flush Combination Outlets:
 - a. Cover: Rectangular.
 - b. Configuration:
 - 1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).

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2) Voice and Data Jacks: As specified in Section 27 30 00.

5. Dual Service Flush Furniture Feed:

a. Cover: Rectangular.

b. Configuration:

1) Power: One 2-1/8 inch by 3/4 inch combination threaded opening(s).

2) Communications: One 2-1/8 inch by 1 inch combination threaded opening(s).

6. Accessories:

a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.

b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

2.12 POKE-THROUGH ASSEMBLIES

A. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.

B. Above-Floor Service Fittings:

1. Single Service Pedestal Convenience Receptacles:

a. Configuration: One standard convenience duplex receptacle.

2. Single Service Pedestal Communications Outlets:

a. Configuration: One 1 inch bushed opening.

b. Voice and Data Jacks: As specified in Section 27 30 00.

3. Single Service Pedestal Furniture Feed:

a. Configuration: One 3/4 inch knockout.

4. Dual Service Pedestal Combination Outlets:

a. Configuration:

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- 1) Power: One standard convenience duplex receptacle.
 - 2) Communications: One 1 inch bushed opening.
 - 3) Voice and Data Jacks: As specified in Section 27 30 00.
- b. Provide barrier to separate line and low voltage compartments.
- C. Flush Floor Service Fittings:
1. Single Service Flush Convenience Receptacles:
 - a. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
 2. Single Service Flush Communications Outlets:
 - a. Voice and Data Jacks: As specified in Section 27 30 00.
 3. Single Service Flush Furniture Feed:
 - a. Configuration: One 2 inch by 1-1/4 inch combination threaded opening(s).
 4. Dual Service Flush Combination Outlets:
 - a. Cover: Hinged door(s).
 - b. Configuration:
 - 1) Power: One standard convenience duplex receptacle(s).
 - 2) Voice and Data Jacks: As specified in Section 27 10 00.
 5. Dual Service Flush Furniture Feed:
 - a. Configuration:
 - 1) Power: One 3/4 inch threaded opening(s).
 - 2) Communications: Two 1/2 inch threaded opening(s).
 6. Accessories:
 - a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

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2.13 ACCESS FLOOR BOXES

- A. Manufacturers - Access Floor Boxes with Pre-wired Connectors for Manufactured Wiring Systems:
 - 1. AFC Cable Systems Inc: www.afcweb.com/#sle.
 - 2. RELOC Wiring Solutions, a brand of Acuity Brands, Inc: www.relocwiring.com/#sle.
 - 3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 4. Or approved equal.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
 - 6. Source Limitations: Provide access floor boxes with pre-wired connectors produced by the same manufacturer as the manufactured wiring system used for this project.
- B. Description: Metallic multi-service box suitable for mounting in access floor system specified in Section 09 69 00.
- C. Access floor boxes with pre-wired connectors for manufactured wiring systems are permitted only where manufactured wiring systems are permitted as specified in Section 26 05 19.
- D. Configuration:
 - 1. Power: Two standard convenience duplex receptacle(s) unless noted otherwise on drawings.
 - 2. Voice and Data Jacks: As specified in Section 27 30 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.

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- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that core drilled holes for poke-through assemblies are in proper locations.
- H. Verify that openings in access floor are in proper locations.
- I. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, except for mounting heights specified in those standards.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1, except for mounting heights specified in that standard.
- C. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor to top of box CEC 1117B.6(5).
 - b. Wall Dimmers: 48 inches above finished floor to top of box CEC 1117B.6(5).
 - c. Fan Speed Controllers: 48 inches above finished floor to top of box CEC 1117B.6(5).
 - d. Receptacles: 18 inches above finished floor or 6 inches above counter.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.

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3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Owner to obtain direction prior to proceeding with work.
 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- D. Install wiring devices in accordance with manufacturer's instructions.
 - E. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
 - F. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
 - G. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
 - H. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - I. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.
 - J. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
 - K. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
 - L. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
 - M. Install wiring devices plumb and level with mounting yoke held rigidly in place.
 - N. Install wall switches with OFF position down.
 - O. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

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- P. Do not share neutral conductor on branch circuits.
- Q. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on right.
- R. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- S. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- T. Identify wiring devices in accordance with Section 26 05 53.
- U. Install identification label for wall switches and wall dimmers in accordance with Section 26 05 26 indicating load served when controlling loads that are not visible from the control location or multiple wall switches or wall dimmers are installed at one location.
- V. Install identification label for all receptacles in accordance with Section 26 05 26 indicating serving branch circuit.
- W. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.
- X. Install receptacles with grounding pole on bottom.
- Y. Connect wiring device grounding terminal to outlet box with bonding jumper.
- Z. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- AA. Connect wiring devices by wrapping conductor around screw terminal.
- BB. Use jumbo size plates for outlets installed in masonry walls.
- CC. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- DD. Install protective rings on active flush cover service fittings.

3.04 CONSTRUCTION

- A. Interface with Other Work

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1. Coordinate locations of outlet boxes to obtain mounting heights specified unless otherwise indicated on drawings. All dimensions are to the center of the item.
 2. Install convenience receptacle four inches above backsplash of counters or four inches above counter if no backsplash. Mount horizontal where indicated.
 3. Install electric water cooler outlet boxes centered behind unit, behind electric water cooler cover. Coordinate with equipment installer.
- B. Locate wall switches on the strike side of door with edge of wall plate three inches from edge of door frame. Where locations are indicated otherwise, notify the Electrical Engineer of Record to obtain direction prior to proceeding with work.

3.05 FIELD QUALITY CONTROL

A. Site Test

1. See Section 01 40 00 - Quality Requirements, for additional requirements.
 2. Operate each wall switch, wall dimmer and fan speed control with circuit energized and verify proper operation.
 3. Test each receptacle to verify operation and proper polarity.
 4. Verify that each receptacle is energized.
 5. Test each GFCI receptacle for proper tripping operation and proper polarity.
 6. Inspect each surge protection receptacle to verify surge protection is active.
- B. Inspect each wiring device for damage and defects.
- C. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.06 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Owner's Representative.

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3.07 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 27 26

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SECTION 26 28 13 - FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 05 73 - Power System Studies: Additional criteria for the selection of protective devices specified in this section.
- D. Section 26 24 13 - Switchboards: Fusible switches.
- E. Section 26 24 16 - Panelboards: Fusible switches.
- F. Section 26 28 16.16 - Enclosed Switches: Fusible switches.

1.03 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.
- E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses; Current Edition, Including All Revisions.
- F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.
- G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

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- H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - a. Fusible Enclosed Switches: See Section 26 28 16.16.
2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
1. Spare Fuse Cabinet: Include dimensions.
- C. Maintenance Materials: Furnish the following for Owner's (Owner's) use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Extra Fuses: Three set(s) of three for each type and size installed.
 3. Fuse Pullers: One set(s) compatible with each type and size installed.
 4. Spare Fuse Cabinet Keys: Two.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Conform to requirements of NFPA 70.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience and with service facilities within 100 miles of Project.
- E. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cooper Bussmann
- B. Ferraz Shawmut, Inc
- C. Littelfuse
- D. Gould
- E. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 APPLICATIONS

- A. Service Entrance:
 - 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
 - 2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- B. Feeders:
 - 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
 - 2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- C. General Purpose Branch Circuits: Class RK1, time-delay.
- D. Individual Motor Branch Circuits: Class RK1, time-delay.
- E. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.
- F. Primary Protection for Control Transformers: Class CC, time-delay.
- G. HVAC equipment: Provide fuses, size, type, and ratings in accordance with equipment nameplate data to be field verified by contractor.

2.03 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.

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- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
 - 1. Class RK1, Time-Delay Fuses:
 - a. Products:
 - 1) Bussmann, "Low-Peak"; 250V KTN-RK and 600V LPS-RK.
 - 2) Littlefuse, "Little-Peak" 250V LLN-RK and 600V LLS-RK.
 - 3) Gould "AMPTRAP II" 250V A2D-R and 600V A6D-R.
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Class RK1, Fast-Acting, Non-Time-Delay Fuses:
 - a. Products:
 - 1) Bussmann "Limitron", 250V KTN-RK and 600V KTS-RK..
 - 2) Littlefuse 250V RLN-R and 600V RLS-R.
 - 3) Gould "AMPTRAP" 250V A2K-R and 600V A6K-R..
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3. Class RK5, Time-Delay Fuses:
 - a. Products:
 - 1) Bussmann "Fusetron" 250V FRN-RK and 600V FRS-RK.
 - 2) Littlefuse "SLO-BLO" 250V FLN-R and 600V FLS-R.
 - 3) Gould "TRI-ONIC" 250V TR-R and 600V TRS-R.
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.

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4. Class RK5, Fast-Acting, Non-Time-Delay Fuses:
 - a. Products:
 - 1) Bussmann 300V "T-Tron" JJN, 600V "Limitron" JKS.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

- H. Class J Fuses: Comply with UL 248-8.
 1. Class J, Time-Delay Fuses:
 - a. Products:
 - 1)
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 2. Class J, Fast-Acting, Non-Time-Delay Fuses:
 - a. Products:
 - 1) Bussmann 300V JJN, 600V JKS.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

- I. Class L Fuses: Comply with UL 248-10.
 1. Class L, Time-Delay Fuses:
 - a. Products:
 - 1) Bussmann "Hi-Cap" 600V, 601-6000A, Type KRP-C.
 - 2) Littlefuse "HI-INT" 600V, 601-6000A, Type KLP-C.
 - 3) Gould "AMPTRAP" 600V, 200-600A, Type A4BY.
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
 2. Class L, Fast-Acting, Non-Time-Delay Fuses:
 - a. Products:
 - 1) Bussmann 300V KTN-R, 600V KTS-R.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

- J. Class T Fuses: Comply with UL 248-15.

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1. Products:
 - a. Bussmann 300V JJN, 600V JJS.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

- K. Class CC Fuses: Comply with UL 248-4.
 1. Class CC, Time-Delay Fuses:
 - a. Products:
 - 1) Bussmann 600V LP-CC.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 2. Class CC, Fast-Acting, Non-Time-Delay Fuses:
 - a. Products:
 - 1) Bussmann 600v, KTK-R.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

- L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

- M. Provide the following accessories where indicated or where required to complete installation:
 1. Fuseholders: Compatible with indicated fuses.
 2. Fuse Reducers: For adapting indicated fuses to permit installation in switch designed for fuses with larger ampere ratings.

2.04 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.
- B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.
- C. Doors: Hinged, with hasp for Owner's (Owner's) padlock.

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PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that mounting surfaces are ready to receive spare fuse cabinet.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet in convenient location in main electrical room unless otherwise indicated on drawings.
- D. Identify spare fuse cabinet in accordance with Section 26 05 53.
- E. Provide identification nameplate for spare fuse cabinet in accordance with Section 26 05 53.

END OF SECTION 26 28 13

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SECTION 26 28 16.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 00 – Common Work Results for Electrical Systems.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 05 73 - Power System Studies: Additional criteria for the selection of equipment and associated protective devices specified in this section.
- G. Section 26 28 13 - Fuses.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

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- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify LP Consulting Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for

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storage, handling, protection, examination, preparation, installation, and starting of product.

- G. Project Record Documents: Record actual locations of enclosed switches.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- I. Maintenance Materials: Furnish the following for Owner's (Owner's) use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. See Section 26 28 13 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

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PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Siemens Industry, Inc: www.usa.siemens.com/#sle.
- E. Cutler-Hammer.
- F. Or approved equal.
- G. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.02 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Seismic Qualification: Provide enclosed safety switches suitable for application under the seismic design criteria specified in Section 26 05 48 where required. Include certification of compliance with submittals.
- D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- E. Horsepower Rating: Suitable for connected load.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Short Circuit Current Rating:

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1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
2. Minimum Ratings:
 - a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
 - b. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
- H. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- I. Provide with switch blade contact position that is visible when the cover is open.
- J. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- K. Conductor Terminations: Suitable for use with the conductors to be installed.
- L. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- M. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- N. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - c. Wash down and corrosive Locations: Type 4X.
 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

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- O. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

- P. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs.
 - b. Provide compression lugs where indicated.
 - c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
 - a. Provide means for locking handle in the ON position where indicated.

- Q. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Hubs: As required for environment type; sized to accept conduits to be installed.
 - 2. Integral fuse pullers.
 - 3. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.
 - 4. Viewing Window: Positioned over switch blades for visual confirmation of contact position with door closed.
 - 5. Interlocked Receptacle: Integral pre-wired three phase, three wire, grounded type receptacle interlocked with switch mechanism to prevent insertion or removal of plug with switch in the ON position and to prevent switch from being placed in the ON position without matching plug inserted. Provide receptacle configuration as required to accept plug as indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.

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- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 05 29.
- E. Provide required seismic controls in accordance with Section 26 05 48.
- F. Install enclosed switches plumb.
- G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- H. Provide grounding and bonding in accordance with Section 26 05 26.
- I. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Identify enclosed switches in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

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3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 28 16.16

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SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Exit signs.
- C. Drivers.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 09 23 - Lighting Control Devices.
 - 1. Includes automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
 - 2. Includes lighting contactors.
- G. Section 26 27 26 - Wiring Devices: Manual wall switches and wall dimmers.
- H. Section 26 56 00 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. C137.0 - Lighting System Terms and Definitions.
- C. C137.1 - 0-10V Dimming Interface for LED Drivers and Controls
- D. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).

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- E. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- F. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.
- G. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- H. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- J. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.
- K. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- L. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- M. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- Q. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- R. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- S. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of

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luminaires and associated trims with mounting surfaces at installed locations.

2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect and/or Owner of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 2. Provide photometric calculations where luminaires are proposed for substitution.
 3. Provide shop drawings for continuous row luminaires.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
 3. Drivers: Include wiring diagrams and list of compatible lamp configurations.

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- D. Samples:
1. Provide one sample(s) of each specified luminaire where indicated.
 2. Provide one sample(s) of each custom luminaire.
 3. Provide one sample(s) of each luminaire proposed for substitution upon request.
 4. Provide one sample(s) of each product finish illustrating color and texture upon request.
- E. Field quality control reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- H. Maintenance Materials: Furnish the following for Owner's (Owmer's) use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
 3. Extra LED Drivers: Two percent of total quantity installed for each type, but not less than one of each type.
- I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC, and ICBO.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Conform to requirements of NFPA 70 and NFPA 101.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

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- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting) and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.
- C. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.
- D. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS - LUMINAIRES

- A. Furnish products as indicated in Lighting Fixture Schedule included on the Drawings
 - 1. General: Lighting fixtures as hereinafter specified are identified by type as noted on drawings. Fixture specifications are based on construction and performance. Manufacturer's catalog numbers are of general nature and indicate the level of quality required, but do not necessarily reflect complete options and accessories required. Approval shall be based on description and specification of fixture as well as catalog number indicated. Verify fixture voltage requirements with circuitry shown on drawings and provide appropriate equipment.

2.02 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

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

2.03 LUMINAIRES

A. Manufacturers:

1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
2. Alloy LED; www.alloyled.com/#sle.
3. Cooper Lighting, a division of Cooper Industries:
www.cooperindustries.com/#sle.
4. Electro-Matic Visual, Inc; www.empvisual.com/#sle.
5. Hubbell Lighting, Inc: www.hubbellighting.com/#sle.
6. Philips Lighting North America Corporation;
www.lightingproducts.philips.com/#sle.
7. Substitutions: See Section 01 60 00 - Product Requirements.

B. Provide products that comply with requirements of NFPA 70.

C. Provide products that are listed and labeled as complying with UL 1598, where applicable.

D. Provide products listed, classified, and labeled as suitable for the purpose intended.

E. Provide products complying with Federal Energy Management Program (FEMP) requirements.

F. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, drivers, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

G. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

H. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

I. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.

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2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- J. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.
- K. LED Luminaires:
1. Components: UL 8750 recognized or listed as applicable.
 2. Tested in accordance with IES LM-79 and IES LM-80.
 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- L. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
1. LED Tape - General Requirements:
 - a. Listed.
 - b. Designed for field cutting in accordance with listing.
 - c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
 2. White LED Tape:
 - a. Correlated Color Temperature (CCT): 4000 K unless otherwise indicated.
 - b. Minimum efficacy: 75 lumens per watt.
 - c. Color Rendering Index (CRI): Not less than 80 Ra.
 - d. R9 value; minimum 30.
 - e. TM30 values; Rf >75, 92>Rg>110.
- M. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.
- N. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

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2.04 EXIT SIGNS

- A. Description: Exit signs and similar signs for special purpose applications such as area of refuge/rescue assistance.
- B. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 - 2. Directional Arrows: As indicated or as required for installed location.
- C. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
 - 1. Manufacturers:
 - a. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - b. Cooper Lighting, a division of Cooper Industries;; www.cooperindustries.com/#sle.
 - c. Hubbell Lighting, Inc: www.hubbellighting.com/#sle.
 - d. Philips Lighting North America Corporation; www.lightingproducts.philips.com/#sle.
 - e. Or approved equal.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Accessories:
 - 1. Provide compatible accessory high-impact polycarbonate vandal shields where indicated.
 - 2. Provide compatible accessory wire guards where indicated.
- E. Manufacturers: Furnish products as indicated in Lighting Fixture Schedule included on the Drawings
- F. Exit Signs: Exit sign fixture suitable for use as emergency lighting unit.
 - 1. Provide fixtures complying with NFPA 101.
 - 2. Lamps: LED.
 - 3. Directional Arrows: Universal type for field adjustment.

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4. Mounting: Universal, for field selection.
5. Battery: 6 or 12 volt, nickel-cadmium type, with 1.5 hour capacity.
6. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
7. Lamps: Manufacturer's standard.

2.05 BALLASTS AND DRIVERS

A. Manufacturers:

1. Alloy LED; www.alloyled.com/#sle.
2. General Electric Company/GE Lighting: www.gelighting.com/#sle.
3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
4. OSRAM Sylvania, Inc: www.osram.us/ds/#sle.
5. Philips Lighting North America Corporation;
www.usa.lighting.philips.com/#sle.
6. Substitutions: See Section 01 60 00 - Product Requirements.
7. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

B. Ballasts/Drivers - General Requirements:

1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

C. LED Drivers:

1. Luminaires shall be equipped with an LED driver(s) that accepts the voltage as indicated on the Fixture Schedule on the drawings. Individual driver(s) shall be replaceable.
2. Driver(s) shall be UL8750 class 2 compliant for their intended use.
3. Total harmonic distortion (THD) for current: $\leq 20\%$.

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4. Driver(s) shall be rated to operate between -30 degrees C to 50 degrees C minimum.
5. Individual drivers shall be equipped with surge protection (6kV minimum) in accordance with IEEE/ANSI C62.4.1. Driver(s) shall be protected against damage due to either an open circuit or short circuit fault condition on the driver output.
6. Driver(s) shall have a minimum efficiency of 85 percent.
7. LED driver(s) shall have a minimum lifetime of 50,000+ hours at 40 degrees C and shall have a minimum efficiency of 80 lumens per watt.
8. LED dies shall be tested in accordance with I.E.S.N.A. LM-80-08 standards.
9. Thermal management shall be passive by design and shall consist of heat sinks with no fans, pumps, or liquids.
10. Dimming Range: Continuous dimming from 100 percent to ten percent relative light output unless dimming capability to lower level is indicated, without flicker.
11. Control Compatibility: Fully compatible with the dimming controls to be installed.
 - a. Wall Dimmers: See Section 26 27 26.
 - b. Daylighting Controls: See Section 26 09 23.
12. Product(s):
 - a. Lutron Hi-Lume Premier 0.1% Constant Voltage (L3D0-Series): 3-wire and digital control; 0.1 percent dimming with Soft-On and Fade-to-Black low end performance; www.lutron.com/#sle.
 - b. Lutron Hi-Lume 1% (L3D-Series): 3-wire and digital control; one percent dimming; www.lutron.com/#sle.
 - c. Lutron Hi-Lume 1% Soft-on Fade-to-Black (LDE1-Series): Digital control; one percent dimming with Soft-On and Fade-to-Black low end performance; www.lutron.com/#sle.

2.06 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

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- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.
- D. Provide wire guards for lighting fixtures and equipment where indicated on the drawings.

2.07 SPARE PARTS

- A. The Contractor shall furnish to the Owner at the completion of the project, a minimum of 5 percent spare LED driver assemblies and light engines for each LED fixture type. LED drivers shall be turned over to the Owner's Representative in their manufacturer's protective packaging. LED drivers not in their protective packaging will not be acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.

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- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Provide required seismic controls in accordance with Section 26 05 48.
- G. Provide seismic sway bracing restraints when an installed suspended luminaire's distance from the nearest permanent object (structural, mechanical, etc.) is less than 0.707 of the total suspension cable (stem) length.
- H. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- I. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
 - 7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- J. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
 - 4. Install recessed luminaires to permit removal from below.

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5. Install clips to secure recessed grid supported luminaires in place. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
- K. Suspended Luminaires:
1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
 4. Install canopies tight to mounting surface.
 5. Unless otherwise indicated, support pendants from swivel hangers.
 6. Provide seismic sway bracing where indicated or as required by the application.
- L. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- M. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
- N. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- O. Support luminaires larger than 2 x 4 foot size independent of ceiling framing.
- P. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- Q. Exposed Grid Ceilings: Support surface mounted luminaires in grid ceiling directly from building structure.
- R. Install wall mounted luminaires and exit signs at height as indicated on Drawings.
- S. Install accessories furnished with each luminaire.

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- T. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture; use flexible conduit.
- U. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- V. Bond products and metal accessories to branch circuit equipment grounding conductor.
- W. Exit Signs:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
 - 2. Install lock-on device on branch circuit breaker serving units.
 - 3. Install pendant exit signs at height indicated. Where not indicated, mount 90 inches above finished floor in space over door frame where applicable
- X. Remote Drivers: Install in accessible location as indicated or as required to complete installation, using conductors per manufacturer's recommendations not exceeding manufacturer's recommended maximum conductor length to luminaire.
- Y. Identify luminaires connected to emergency power system in accordance with Section 26 05 53.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by LP Consulting Engineers, Inc..
- F. Re-lamp luminaires that have failed lamps at substantial completion.

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3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by LP Consulting Engineers, Inc.. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by LP Consulting Engineers, Inc. or authority having jurisdiction.
- C. Air-Handling Luminaires with Air Control Blades or Heat Removal Dampers: Adjust as indicated or as required for proper airflow as directed by LP Consulting Engineers, Inc..
- D. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by LP Consulting Engineers, Inc. or authority having jurisdiction.
- E. Aim and adjust fixtures as indicated and/or as directed by the Architect or Electrical Engineer of Record.
- F. Position exit sign directional arrows as indicated.

3.06 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean finishes and touch up damage.
- E. Clean photometric control surfaces as recommended by manufacturer.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to LP Consulting Engineers, Inc. or designated representative, and correct deficiencies or make adjustments as directed.

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D. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

3.09 SCHEDULE - SEE DRAWINGS

END OF SECTION 26 51 00

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SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior luminaires.
- B. Ballasts and Drivers.
- C. Poles and accessories.
- D. Luminaire accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.
- F. Section 26 09 23 - Lighting Control Devices.
 - 1. Includes automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.
 - 2. Includes lighting contactors.
- G. Section 26 27 26 - Wiring Devices: Receptacles for installation in poles.
- H. Section 26 28 13 - Fuses.
- I. Section 26 51 00 - Interior Lighting.

1.03 REFERENCE STANDARDS

- A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals; 2013, with Editorial Revision (2022).
- B. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.

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- C. ANSI O5.1 - American National Standard for Wood Poles: Specifications and Dimensions; 2022.
- D. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
- E. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- F. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- G. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.
- H. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- I. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- J. IES RP-8 - Recommended Practice: Lighting Roadway and Parking Facilities; 2022.
- K. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- L. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).
- M. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- N. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.
- O. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- Q. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- R. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

LP Consulting Engineers, Inc.
LPCE Project #: 24-2001

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1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 2. Notify Architect and/or District Representative of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Coordination: Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 2. Provide photometric calculations where luminaires are proposed for substitution.
 3. Provide structural calculations for each pole proposed for substitution.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
 3. LED Retrofit Luminaire Conversion Kits: Include list of compatible luminaires and/or criteria for compatibility.
 4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

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- D. Sustainable Design Documentation: Submit manufacturer's product data on lamp mercury content and rated lamp life, showing compliance with specified requirements.
- E. Samples:
 - 1. Provide one sample(s) of each specified luminaire where indicated.
 - 2. Provide one sample(s) of each luminaire proposed for substitution upon request.
 - 3. Provide one sample of each product finish illustrating color and texture upon request.
- F. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.
- G. Field Quality Control Reports.
 - 1. Include test report indicating measured illumination levels.
- H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- I. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- J. Maintenance Materials: Furnish the following for Owner's (Owner's) use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Fuses: Five percent of total quantity installed for each type, but not less than two of each type.
 - 3. Touch-Up Paint: 2 gallons, to match color of pole finish.
- K. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Conform to requirements of NFPA 70.

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- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- C. Receive, handle, and store wood poles in accordance with ANSI O5.1.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide 2-year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LUMINAIRES

- A. Manufacturers:
 - 1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 - 2. Alloy LED; www.alloyled.com/#sle.
 - 3. Cooper Lighting, a division of Cooper Industries:
www.cooperindustries.com/#sle.

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4. Electro-Matic Visual, Inc; www.empvisual.com/#sle.
 5. Hubbell Lighting, Inc: www.hubbellighting.com/#sle.
 6. Philips Lighting North America Corporation;
www.lightingproducts.philips.com/#sle.
 7. _____.
 8. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Provide products complying with Federal Energy Management Program (FEMP) requirements.
- F. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- G. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- H. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- I. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- J. Recessed Luminaires:
1. Ceiling Compatibility: Comply with NEMA LE 4.
 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
- K. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.

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- L. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.
- M. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- N. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
 - 1. LED Tape - General Requirements:
 - a. Listed.
 - b. Designed for field cutting in accordance with listing.
 - c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
 - 2. White LED Tape:
 - a. Correlated Color Temperature (CCT): 4000 K unless otherwise indicated.
 - b. Color Rendering Index (CRI): Not less than 70 Ra.
 - c. Minimum efficacy: 100 lumens per watt.
 - d. R9 value; minimum 20.
 - e. TM30 values; Rf >70, 80 > Rg > 120.
- O. Exposed Hardware: Stainless steel.
- P. Finish: To be verified with the architect by contractor prior to ordering.

2.03 BALLASTS AND DRIVERS

- A. Manufacturers:
 - 1. General Electric Company/GE Lighting: www.gelighting.com/#sle.
 - 2. OSRAM Sylvania, Inc: www.osram.us/ds/#sle.

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3. Philips Lighting North America Corporation;
www.usa.lighting.philips.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
 5. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
 6. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.
- B. Ballasts/Drivers - General Requirements:
1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
- C. Dimmable LED Drivers:
1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.04 POLES

- A. Manufacturers:
1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
 2. Cooper Lighting, a division of Cooper Industries
: www.cooperindustries.com/#sle.
 3. Hubbell Lighting, Inc: www.hubbellighting.com/#sle.
 4. Philips Lighting North America Corporation;
www.lightingproducts.philips.com/#sle.
 5. RAB Lighting, Inc; _____: www.rablighting.com/#sle.
 6. Substitutions: See Section 01 60 00 - Product Requirements.

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B. All Poles:

1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
2. Structural Design Criteria:
 - a. Comply with AASHTO LTS.
 - b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
 - 1) Design Wind Speed: 100 miles per hour, with gust factor of 1.3.
 - c. Dead Load: Include weight of proposed luminaire(s) and associated supports and accessories.
 - d. Include structural calculations demonstrating compliance with submittals.
3. Material: Steel, unless otherwise indicated.
4. Shape: Square straight, unless otherwise indicated.
5. Finish: Match luminaire finish, unless otherwise indicated.
6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
7. Unless otherwise indicated, provide with the following features/accessories:
 - a. Top cap.
 - b. Handhole, standard size.
 - c. Anchor bolts with leveling nuts or leveling shims.
 - d. Anchor base cover.
 - e. Provision for pole-mounted weatherproof GFI receptacle where indicated.
 - f. Brackets: As required by manufacturer.
 - g. Hinged base.
 - h. Pole-top tenon, as indicated on the drawings.

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- C. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

2.05 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.
- D. Poles: Per drawing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires in accordance with NECA/IESNA 501.

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- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Provide required seismic controls in accordance with Section 26 05 48.
- G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- H. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Suspended Luminaires:
 - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 - 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet between supports.
 - 4. Install canopies tight to mounting surface.
 - 5. Unless otherwise indicated, support pendants from swivel hangers.
- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- K. Pole-Mounted Luminaires:
 - 1. Maintain the following minimum clearances:
 - a. Comply with IEEE C2.
 - b. Comply with utility company requirements.
 - 2. Foundation-Mounted Poles:
 - a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 30 00.

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- 1) Install anchor bolts plumb per template furnished by pole manufacturer.
- 2) Position conduits to enter pole shaft.
- b. Install foundations plumb.
- c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
- d. Tighten anchor bolt nuts to manufacturer's recommended torque.
- e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
- f. Install anchor base covers or anchor bolt covers as indicated.
3. Embedded Poles: Install poles plumb as indicated.
4. Grounding:
 - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
 - b. Provide supplementary ground rod electrode as specified in Section 26 05 26 at each pole bonded to grounding system as indicated.
5. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
6. Install non-breakaway in-line fuse holders and fuses complying with Section 26 28 13 in pole handhole or transformer base for each ungrounded conductor.
7. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 26 27 26 in designated poles.
- L. Install accessories furnished with each luminaire.
- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. Provide concrete bases for lighting poles at locations indicated, in accordance with detail on drawing.
- O. Install poles plumb.
 1. Provide shims to adjust plumb.

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- 2. Grout around each base.
- P. Install lamps in each luminaire.
- Q. Bond luminaires, metal accessories, and metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by LP Consulting Engineers, Inc..
- E. Measure illumination levels at night with calibrated meters to verify compliance with performance requirements. Record test results in written report to be included with submittals.
- F. Measure illumination levels to verify conformance with performance requirements. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by LP Consulting Engineers, Inc.. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by LP Consulting Engineers, Inc..

3.06 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosure.

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D. Clean finishes and touch up damage.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to LP Consulting Engineers, Inc., and correct deficiencies or make adjustments as directed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 56 00