

**SPECIFICATIONS FOR
TENANT IMPROVEMENTS
OF**

**MENTAL HEALTH ADMINISTRATION BUILDING
FM05410004665**

(4095 County Circle Dr., Riverside)

**COUNTY OF RIVERSIDE
FACILITIES MANAGEMENT**

November 2013

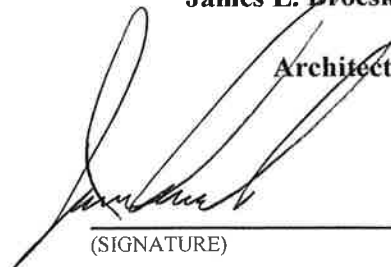
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SECTION 017300 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes procedural requirements for cutting and patching.

1.2 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural element 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.
 - 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.
 - 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, in Architect's opinion, would reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.3 WARRANTY

- A. Existing Warranties: Remove replace, patch and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties

PART 2 - PRODUCTS

2.1 MATERIALS

- A. 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.

PART 3 - IEXECUTON

3.1 EXAMINATION

- A. Examination and Acceptance of Conditions: Before proceeding with cutting and patching, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. 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.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. 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 minimize interruption to occupied areas.

3.3 CUTTING AND PATCHING PERFORMANCE

- A. Cutting and Patching, 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. 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. 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.
 5. Proceed with patching after construction operations requiring cutting are complete.
- D. 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. 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 minimize evidence of patching and refinishing.
 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.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- E. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

END OF SECTION 017300

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Framing with dimension lumber.
 - 2. Rooftop equipment bases and support curbs.
 - 3. Wood blocking, cants, and nailers.
 - 4. Wood furring and grounds.
 - 5. Wood sleepers.
 - 6. Plywood backing panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Power-driven fasteners.
 - 4. Powder-actuated fasteners.
 - 5. Expansion anchors.
 - 6. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

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

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

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA U1.

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 that 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, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying 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 E 84, 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. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 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. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings.

2.4 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: No.2 grade.
 - 1. Species: Douglas fir-larch
- B. Load-Bearing Interior and Exterior Walls: As indicated on Structural Drawings.
 - 1. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.

2.5 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.
 - 5. Furring.
 - 6. Grounds.
- B. For items of dimension lumber size, provide No. 2 grade lumber of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
 - 1. Douglas fir-larch; No.2; WCLIB or WWPA

2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than **3/4-inch** nominal thickness.

2.7 FASTENERS

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

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.
- B. Nails: As indicated on Drawings.
- C. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.8 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation.
 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 1. Use for wood-preservative-treated lumber and where indicated.

2.9 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.

- F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

3.2 PROTECTION

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

END OF SECTION 061000

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber blanket insulation.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research/evaluation reports.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. Guardian Building Products, Inc.
 - 3. Johns Manville.
 - 4. Knauf Insulation.
 - 5. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- C. Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- 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. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber or Mineral-Wool 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 metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 5. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
 - a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
 - b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

END OF SECTION 072100

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples: For factory-finished doors.

1.3 INFORMATIONAL SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

A. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products to match existing doors.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
 - 1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.

2.3 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.

2.4 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors that are indicated to receive transparent finish.
- C. Use only paints and coatings that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Transparent Finish:

1. Grade: Match existing doors.
2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards".
3. Finish: Match existing doors.
4. Staining: Match existing doors.
5. Effect: Match existing doors.
6. Sheen: Match existing doors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- B. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 081416

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Texture finishes.

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Samples:

1. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.
2. Trim Accessories: Full-size sample in 12-inch-long length for each trim accessory indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. PABCO Gypsum.
7. Temple-Inland.
8. USG Corporation.

- B. Gypsum Board, Type X: ASTM C 1396.

1. Thickness: 5/8 inch.

2. Long Edges: Tapered.
- C. Foil-Backed Gypsum Board: ASTM C 1396.
1. Core: 5/8 inch (15.9 mm), Type X.
 2. Long Edges: Tapered.

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
- B. Aluminum Trim: ASTM B 221, Alloy 6063-T5.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
1. Interior Gypsum Board: Paper.
- 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.

2.5 AUXILIARY MATERIALS

- A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing).
- D. Acoustical Joint Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90.
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. Accumetric LLC.
 - b. Grabber Construction Products.
 - c. Pecora Corporation.
 - d. Specified Technologies, Inc.

2.6 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.

- B. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; ProRoc Wall and Ceiling Spray Texture.
 - b. Georgia-Pacific Gypsum LLC; ToughRock Ceiling Textures/Vermiculite.
 - c. USG Corporation; SHEETROCK Wall and Ceiling Spray Texture (Aggregated).
 - 2. Texture: Light spatter.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. 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.
- D. Install 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.
- E. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
- H. Texture Finish Application: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.
- I. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- J. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical panels.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of product.
- B. Samples: Minimum 6 inch x 6inch samples of specified acoustical panel.
- C. Shop Drawings: Layout and details of acoustical ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.
- D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.
- E. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
- B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
 - a. Flame Spread: 25 or less
 - b. Smoke Developed: 50 or less
- C. Seismic Performance: Provide acoustical ceiling system that has been evaluated by an independent party and found to be compliant with the 2003 International Building Code, Seismic Category D, E, and F.
 - 1. Tested per International Code Council - Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components as evidenced by International Code Council Evaluation Report, ESR-1308.

- D. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.5 PROJECT CONDITIONS

A. Space Enclosure:

1. All ceiling products and suspension systems must be installed and maintained in accordance with Armstrong written installation instructions for that product in effect at the time of installation and best industry practice. Prior to installation, the ceiling product must be kept clean and dry, in an environment that is between 32°F (0°C) and 120°F (49°C) and not subject to Abnormal Conditions.
 - a. Abnormal conditions include exposure to chemical fumes, vibrations, moisture from conditions such as building leaks or condensation, excessive humidity, or excessive dirt or dust buildup.
2. HumiGuard Plus Ceilings: Installation of the products shall be carried out where the temperature is between 32°F (0° C) and 120°F (49° C). It is not necessary for the area to be enclosed or for HVAC systems to be functioning. All wet work (plastering, concrete, etc) must be complete and dry.
3. The ceilings must be maintained to avoid excessive dirt or dust buildup that would provide a medium for microbial growth on ceiling panels. Microbial protection does not extend beyond the treated surface as received from the factory, and does not protect other materials that contact the treated surface such as supported insulation materials.

1.6 WARRANTY

- A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
 1. Acoustical Panels: Sagging and warping as a result of defects in materials or factory workmanship.
- B. Warranty Period Humiguard:
 1. Acoustical panels: Ten (10) years from date of substantial completion.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.7 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Ceiling Panels:
 - 1. Armstrong World Industries, Inc.

2.2 ACOUSTICAL CEILING UNITS

- A. Acoustical Panels Type ACT-1:
 - 1. Surface Texture: Fine
 - 2. Composition: Mineral Fiber
 - 3. Color: White
 - 4. Size: 48in X 24in X 3/4in
 - 5. Edge Profile: Angled Tegular for interface with compatible Armstrong grid.
 - 6. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton, 0.50.
 - 7. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton, 35
 - 8. Emissions Testing: Section 01350 Protocol, < 13.5 ppb of formaldehyde when used under typical conditions required by ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality"
 - 9. Flame Spread: ASTM E 1264; Class A (UL)
 - 10. Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: 0.83.
 - 11. Dimensional Stability: HumiGuard Plus - Temperature is between 32°F (0° C) and 120°F (49° C). It is not necessary for the area to be enclosed or for HVAC systems to be functioning. All wet work (plastering, concrete, etc) must be complete and dry.
 - 12. Antimicrobial Protection: BioBlock Plus - Resistance against the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.
 - 13. Acceptable Product: **Dune Second Look, 2712** as manufactured by Armstrong World Industries, or equal as approved by Architect and/or Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 INSTALLATION

- A. Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
 - 1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

3.3 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.
 - 1. Ceiling Touch-Up Paint, (Item #5760, 8oz. bottles) (Item #5761, quart size cans), "global white" latex paint should be used to hide minor scratches and nicks in the surface and to cover field tegularized edges that are exposed to view.
- C. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical tiles and concealed suspension systems for ceilings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Evaluation reports.
- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP.
- B. 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 typical ceiling area as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 450 or less.

2.2 ACOUSTICAL TILE CEILINGS, GENERAL

- A. Acoustical Tile Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.3 ACOUSTICAL TILES

- A. Manufacturers: Subject to compliance with requirements, provide products to match existing acoustical tiles.
- B. Classification: Match existing acoustical tiles.
- C. Color: Match existing product.
- D. Edge/Joint Detail: Match existing ceiling.
- E. Thickness: Match existing ceiling.
- F. Modular Size: Match existing product.

2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products to match existing system
- B. Structural Classification: Match existing product.
- C. Access: Match existing ceiling.
- D. Roll-Formed, Sheet-Metal Edge Moldings and Trim: 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 exposed flanges of suspension-system runners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install acoustical tile ceilings to comply with ASTM C 636 and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- 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, and comply with layout shown on reflected ceiling plans.
- C. Arrange directionally patterned acoustical tiles as indicated on reflected ceiling plans.

END OF SECTION 095123

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Gypsum board.

1.2 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

1.3 SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.
- C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 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 specified in Part 3.
 - 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Dunn Edwards Paints
 2. Frazee Paints
 3. Pratt & Lambert Paints
 4. Sherwin-Williams

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 1. Provide materials for use within each paint system that are 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, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 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. Wood: 15 percent.
 2. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. 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.
- C. 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.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
- B. 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.

3.4 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.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board Substrates:
 - 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior.
 - b. Prime Coat: Latex, interior, matching topcoat.
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - d. Topcoat: Latex, interior, flat, (Gloss Level 1).

END OF SECTION 099123

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes manually operated roller shades.

1.2 REFERENCES

- A. Flame –resistant materials shall pass or exceed one or more of the following tests:
 - 1. National Fire Protection Association (NFPA) 701 (small scale for horizontal applications).
 - 2. California Administrative Code Title 19

1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Roller-Shade Schedule: Use same designations indicated on Drawings.
- E. Product certificates.
- F. Product test reports.
- G. Maintenance data.

1.4 QUALITY ASSURANCE

- A. Supplier: Manufacturer, subsidiary or licensed agent shall be approved to supply the products specified, and to honor any claims against product presented in accordance with warranty.
- B. Installer Qualifications: Installer or agent shall be qualified to install specified products by prior experience, demonstrated performance and acceptance of requirements of manufacturer, subsidiary, or licensed agent. Installer shall be responsible for an acceptable installation.
- C. Uniformity: Provide Manual Roller Shades of only one manufacturer for entire project.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Product shall be delivered to site in manufacturer's original packaging.
- B. Product shall be handled and stored to prevent damage to materials, finishes and operating mechanisms.

1.6 JOB CONDITIONS

- A. Prior to shade installation, building shall be enclosed.
- B. Interior temperature shall be maintained between 60° F. and 90° F. during and after installation; relative humidity shall not exceed 80%. Wet work shall be complete and dry.

1.7 WARRANTY

- A. Lifetime Limited Warranty. Fabrics warranted for 5 years. Specific product warranties available from manufacturer or its authorized agent

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. **Hunter Douglas Contract 12250 Parkway Centre Dr. Poway, CA 92064 Phone: 800-727-8953 Fax: 800-205-9819 Website: www.hunterdouglascontract.com**, or architect approved equivalent. Contact the following for project assistance and dealer referral @ 800-964-2580: David Cover ext. #827313.
- B. Request for substitutions must be approved by architect minimum of 30 days prior to close of bid.

2.2 MANUAL ROLLER SHADES

- A. **PRODUCT: Hunter Douglas Contract "RB 500 Manual Roller Shades"** or equal as approved by Architect and/or Owner.
- B. **MATERIALS:**
 - 1. **FABRICS:** Inherently anti-static, flame retardant, fade and stain resistant, light filtering, room darkening, and blackout fabrics providing 0% - 14% openness factors. Fabric weights to range between 6.00 oz/sq.yd. - 20.70 oz/sq.yd., containing fiberglass, PVC, polyester, acrylic, vinyl laminates, cotton, and vinyl coatings. Finish selected by architect from manufacturer's available contract colors.
 - 2. **CONTROL SYSTEMS:**
 - a. **Clutch-Operated:** Engineered heavy duty chain drive pulley operating system consisting of metal clutch housing and locking plug containing minimum 6 ribs and inserted at minimum of 2-1/4" into roller tube. Lift torque enhancement provided by Counter Balance System with integrated spring support module. Utilization of adjustment-free continuous qualified T304 stainless steel ball chain with 110 lbs

breaking strength for precise control, smooth operation and ensuring a uniform look. Chain tensioner to be compliant with WCMA safety standard A100.1-2010 and must prevent the clutch system from moving the roller shade through lowering and raising if not properly installed as specified in ANSI Standard Section 6.5.2. Components will be maintenance free from adjustments or lubrication for trouble-free operation.

3. ROLLER TUBE: Circular-shaped aluminum tube extruded from alloy and temper 6063 T-6. 2" outside diameter extruded tube to have a .063" wall thickness (2.5" outside diameter to have a .079" wall thickness). Heavily reinforced with minimum six internal ribs providing additional tensile strength and allows for secure placement of clutch and end plug.
4. END PLUG: Heat-stabilized fiber-reinforced plastic outside sleeve and center shaft provide bearing surfaces on which the roller rides ensuring smooth, wear-resistant operation.
5. BOTTOM BAR: Sealed Hem Bar – Extruded aluminum weight in a sealed fabric hem pocket provides uniform look.
6. MOUNTING HARDWARE: Manufacturer's standard heavy duty bracket constructed of hardened 1/8" thick steel to support full weight of shade with bracket & screw hole covers to provide uniform look. Integrated leveling device for enhanced level adjustment of overall shade. Locking mechanism on bracket adapter provides for a secure installation and removal of the shade.

2.3 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Shade measurements shall be accurate to within $\pm 1/8$ " or as recommended in writing by manufacturer
- C. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
 2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

PART 3 - EXECUTION

3.1 INSPECTION

- A. SUBCONTRACTOR shall be responsible for inspection on site, approval of mounting surfaces, installation conditions and field measurement for this work.

3.2 ROLLER-SHADE INSTALLATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Install roller shades level, plumb, and aligned with adjacent units, according to manufacturer's written instructions.
- D. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- E. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

END OF SECTION 122413

SECTION 210500 - FIRE PROTECTION BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe, fittings, valves, and connections for sprinkler, standpipe and fire hose, and combination sprinkler and standpipe systems.

1.02 RELATED REQUIREMENTS

- A. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.
- B. Section 21 12 00 - Fire-Suppression Standpipes: Standpipe design.

1.03 REFERENCE STANDARDS

- A. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2010.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; The American Society of Mechanical Engineers; 2011.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers; 2009 (ANSI/ASME B16.5).
- D. ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings; The American Society of Mechanical Engineers; 2007.
- E. ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded; The American Society of Mechanical Engineers; 2011.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- G. ASTM A135/A135M - Standard Specification for Electric-Resistance Welded Steel Pipe; 2009.
- H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2011a.
- I. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2013.
- J. ASTM A 536/A 536M - Standard Specification for Ductile Iron Castings; 2004
- K. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association; 2010 (ANSI/AWWA C105/A21.5).
- L. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2013.

- M. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- N. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- C. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and shall be specifically identified with the applicable style or series designation
- D. Project Record Documents: Record actual locations of components and tag numbering.
- E. Operation and Maintenance Data: Include installation instructions and spare parts lists.
- 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.

PART 2 - PRODUCTS

2.01 FIRE PROTECTION SYSTEMS

- A. Sprinkler Systems: Conform work to NFPA 13.
- B. Standpipe and Hose Systems: Conform to NFPA 14.
- C. Welding Materials and Procedures: Conform to ASME Code.
- D. Grooved Joint Components: All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- E. Castings: All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

2.02 BURIED PIPING

- A. PVC Pipe: Class 200 PVC C-900
- B. Steel Pipe: ASTM A53/A53M Schedule 40 or ASTM A 135/A 135M Schedule 10, black, with AWWA C105 polyethylene jacket, or double layer, half-lapped polyethylene tape.

1. Steel Fittings: ASME B16.9, wrought steel, butt welded; with double layer, half-lapped polyethylene tape.
2. Casing: Closed glass cell insulation.

2.03 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A795 Schedule 10, ASTM A53 Schedule 40, or ASTM A135/A135M UL listed light wall type, black.

1. Steel Fittings: ASME B16.9, wrought steel, butt welded, ASTM A 234/A 234M, wrought carbon steel or alloy steel, ASME B16.5, steel flanges and fittings, or ASME B16.11, forged steel socket welded and threaded.
2. Malleable Iron Fittings: ASME B16.3, threaded fittings.
3. Mechanical Grooved Couplings: Two ductile iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, ASTM A449 electroplated steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - a. Rigid Type: Housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with NFPA-13. Couplings shall be fully installed at visual pad-to-pad offset contact. (Tongue and recess type couplings, or any coupling that requires exact gapping of bolt pads on each side of the coupling at specified torque ratings, are not allowed.)
 - 1) 1-1/4" through 8": Installation-Ready, for direct stab installation without field disassembly. Victaulic Style 009-EZ and Style 107H.
 - 2) Victaulic FireLock™ Style 005 and Zero-Flex Style 07
 - b. Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for seismic applications in accordance with the manufacturer's recommendations. Victaulic Installation-Ready Style 177 or Style 75 / 77.
 - c. Gaskets:
 - 1) Dry Systems, Ambient Temp Range - FlushSeal®, Grade EPDM, Type A
 - 2) Freezer Applications, -40°F to 0°F - FlushSeal®, Grade L, Silicone
 - 3) Water / Wet Systems, Ambient Temp Range - Grade EPDM, Type A

2.04 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- C. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- D. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- E. Vertical Support: Steel riser clamp.

2.05 GATE VALVES

- A. Up to and including 2 inches:

1. Manufacturers:
 - a. Victaulic: www.victaulic.com.
 - b. Nibco, Inc: www.nibco.com.
 - c. Milwaukee Valve Company: www.milwaukeevalve.com.
 - d. Stockham: www.stockham.com
2. Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.

B. Over 2 inches:

1. Manufacturers:
 - a. Victaulic: www.victaulic.com. Victaulic Series 771
 - b. Nibco, Inc: www.nibco.com.
 - c. Milwaukee Valve Company: www.milwaukeevalve.com.
 - d. Stockham: www.stockham.com
2. Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid rubber covered bronze or cast iron wedge, flanged or grooved ends.

2.06 GLOBE OR ANGLE VALVES

A. Up to and including 2 inches:

1. Manufacturers:
 - a. Nibco, Inc: www.nibco.com.
 - b. Milwaukee Valve Company: www.milwaukeevalve.com.
 - c. Stockham: www.stockham.com
2. Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable rubber disc, threaded ends, with backseating capacity repackable under pressure.

B. Over 2 inches:

1. Manufacturers:
 - a. Nibco, Inc: www.nibco.com.
 - b. Milwaukee Valve Company: www.milwaukeevalve.com.
 - c. Stockham: www.stockham.com
2. Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.07 BALL VALVES

A. Up to and including 2 inches:

1. Manufacturers:
 - a. Victaulic: www.victaulic.com. Victaulic Series 728
 - b. Nibco, Inc: www.nibco.com.
 - c. Milwaukee Valve Company: www.milwaukeevalve.com.
 - d. Stockham: www.stockham.com
2. Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, grooved ends or threaded ends with union.

3. UL listed and FM approved valves shall include a weatherproof actuator housing with handwheel and supervisory switches.
- B. Over 2 inches:
1. Manufacturers:
 - a. Victaulic: www.victaulic.com. Series 726 (unlisted valves)
 - b. Nibco, Inc: www.nibco.com.
 - c. Milwaukee Valve Company: www.milwaukeevalve.com.
 - d. Stockham: www.stockham.com
 2. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 10 inches and over, flanged or grooved ends.

2.08 BUTTERFLY VALVES

- A. Cast or Ductile Iron Body
1. Manufacturers:
 - a. Victaulic: www.victaulic.com; Product Series 705.
 2. Ductile iron body, electroless-nickel coated ductile iron disc, pressure responsive Nitrile seat, stainless steel stem, and grooved ends. (Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating.)
 3. UL listed and FM approved.
 4. Valves shall include a weatherproof actuator housing with handwheel and supervisory switches

2.09 CHECK VALVES

- A. Over 2 inches:
1. Manufacturers:
 - a. Victaulic: www.victaulic.com; Product Series 717.
 - b. Nibco, Inc: www.nibco.com.
 - c. Milwaukee Valve Company: www.milwaukeevalve.com.
 - d. Stockham: www.stockham.com
 2. Ductile iron body, bronze disc, stainless steel spring and shaft, resilient seal, threaded, wafer, grooved, or flanged ends.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Goove or Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

- D. Unions and flanges for servicing and disconnect are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points.)

3.02 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
 - 1. In grooved installations, use Victaulic rigid couplings with offsetting angle-pattern bolt pads, which permit support and hanging in accordance with NFPA-13.
- B. Install standpipe piping, hangers, and supports in accordance with NFPA 14.
- C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- D. Install piping to conserve building space, to not interfere with use of space and other work.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipes passing through partitions, walls, and floors.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Pipe Hangers and Supports:
 - 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 2. Place hangers within 12 inches of each horizontal elbow.
 - 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- I. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- J. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)
- K. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00.

- L. Do not penetrate building structural members unless indicated.
 - M. Provide sleeves when penetrating footings, floors, and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - N. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
-
- O. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
 - P. Provide drain valves at main shut-off valves, low points of piping and apparatus.

END OF SECTION 210500

SECTION 211300 - FIRE SUPPRESSION SPRINKLERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.

1.02 REFERENCE STANDARDS

- A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2013.
- C. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
 - 1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed
- C. Shop Drawings:
 - 1. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
 - 2. Submit shop drawings to authority having jurisdiction for approval. Submit proof of approval to Architect.
- D. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- E. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.

- F. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
 - 2. Sprinkler Wrenches: For each sprinkler type.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of referenced design and installation standard on site.
- B. Conform to UL requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience approved by manufacturer.
- E. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Sprinklers, Valves, and Equipment:
 - 1. Victaulic Company: www.victaulic.com.
 - 2. Tyco Fire Products: www.tyco-fire.com.
 - 3. Viking Corporation: www.vikinggroupinc.com.

2.02 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for entire building.
- B. Occupancy: Ordinary hazard, Group 1; comply with NFPA 13.
- C. Water Supply: Determine volume and pressure from water flow test data.
- D. Interface system with building fire and smoke alarm system.

- E. Provide fire department connections where indicated.
- F. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

2.03 SPRINKLERS

- A. Sprinklers shall be glass bulb type, with hex-shaped wrench boss integrally cast into the sprinkler body.
 - 1. Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body. Basis of Design: Victaulic FireLock Series.
 - 2. Sprinklers with rubber-O-rings are not permitted
- B. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
 - 1. Response Type: Quick.
 - 2. Coverage Type: Standard.
 - 3. Finish: Brass.
 - 4. Escutcheon Plate Finish: Enamel, color as selected.
 - 5. Product: Victaulic Model V27.
- C. Storage Sprinklers: Concealed upright type with guard.
 - 1. Response Type: Standard.
 - 2. Finish: Chrome plated.
 - 3. Product: Victaulic Model V38 and V39.
- D. Guards: Finish to match sprinkler finish.
- E. Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer

2.04 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, aluminum-bronze clapper with elastomer seal or rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve. Alarm valve internal components shall be replaceable without removing the valve from the installed position.
 - 1. Product: Victaulic Series 751.
- B. Fire Department Connections:
 - 1. Type: Free standing type with ductile iron pedestal red enamel finish.
 - 2. Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
 - 3. Drain: 3/4 inch automatic drip, outside.
 - 4. Label: "Sprinkler - Fire Department Connection".

5. At the low-point near each fire department connection, install a 90-degree elbow with drain connection to allow for system drainage to prevent freezing. Basis of Design: Victaulic #10-DR

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Provide approved double check valve assembly at sprinkler system water source connection.
- D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- E. Locate outside alarm gong on building wall as indicated.
- F. Place pipe runs to minimize obstruction to other work.
- G. Place piping in concealed spaces above finished ceilings.
- H. Center sprinklers in one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements.
 1. The Victaulic Aquaflex multiple-use open-gate stainless steel flexible drop system may be used to properly locate sprinkler heads. The drop system shall be supplied with required supporting members and bracing
- I. Sprinkler bulb protector shall be removed by hand after installation. Do not use tools or any other device(s) to remove the protector that could damage the bulb in any way.
- J. Do not install sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.
- K. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- L. Flush entire piping system of foreign matter.
- M. Install guards on sprinklers where indicated.
- N. Hydrostatically test entire system.
- O. Require test be witnessed by Fire Marshal.

END OF SECTION 211300

SECTION 220010 - BASIC PLUMBING REQUIREMENTS

PART 1. GENERAL

1.01 SECTION INCLUDES

- A. Basic Plumbing Requirements specifically applicable to Division 22 Sections, in addition to Division 01 - General Requirements.

1.02 DESCRIPTION

- A. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as required to complete the work of this section, except as otherwise herein specifically excluded.

1.03 WORK INCLUDED

- A. The complete Plumbing systems (including Fire Protection systems), including but not limited to these major items.
 - 1. Coordinate work of this Section with related trades.
 - 2. Verify applicable dimensions at the jobsite.
 - 3. Furnishing and installation of miscellaneous hangers, supports, sleeves, inserts, anchors and other auxiliary equipment for systems under this Division.
 - 4. Plumbing fixtures, carriers, fittings, trim, hose bibs, wall hydrants, and accessories.
 - 5. Shop drawings.
 - 6. Record drawings.
 - 7. Guarantee

1.04 WORK SPECIFIED ELSEWHERE

- A. Concrete, Architectural Sheet Metal, Door and Exterior Wall Louvers, Painting and Electrical.

1.05 SITE INSPECTION

- A. Contractor shall familiarize himself with the conditions at the site. No allowance will be made subsequently for any error through negligence in observing the site conditions. Contractor shall observe and make cost allowance for any mechanical and/or electrical items that must be relocated to accommodate the installation or servicing of any item covered under this contract.

1.06 ORDINANCES, REGULATIONS AND CODES

- A. References to Technical Societies, Trade Organizations, Governmental Agencies is made in Division 15 in accordance with the following abbreviations.
 - 1. AFI - Air Filter Institute

2. AMCA - Air Moving & Conditioning Association
3. ARI - Air Conditioning & Refrigeration Institute
4. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
5. ASME - American Society of Mechanical Engineers
6. ASTM - American Society of Testing Materials
7. AWS - American Welding Society Code
8. ANSI - American National Standards Institute
9. CBC - California Building Code
10. CCR - California Code of Regulations
11. CEC - California Electrical Code
12. CFC - California Fire Codes
13. CMC - California Mechanical Code
14. CPC - California Plumbing Code
15. FIA - Factory Insurance Association
16. NAFM - National Association of Fan Manufacturers
17. NEMA - National Electrical Manufacturer's Association
18. NFPA - National Fire Protection Association
19. ORS - Office of Regulatory Services
20. SCAQMD - South Coast Air Quality Management District
21. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
22. UFC - Uniform Fire Code
23. UL - Underwriter's Laboratories
24. UPC - Uniform Plumbing Code

- B. Requirements of Regulatory Agencies: Materials and installation shall comply with applicable local, state, and national codes and ordinances. Rulings and interpretations of the enforcing agencies shall be considered as part of the local codes. No extras will be permitted for furnishing items required by the local codes but not specified or shown on the drawings.
- C. Codes and Standards:
1. UBC and California Amendments (California Building Code - Part 2, Title 24, CCR).
 2. UMC and California Amendments (California Mechanical Code - Part 4, Title 24 CCR).
 3. UPC and California Amendments (California Plumbing Code - Part 5, Title 24 CCR).
 4. Uniform Fire Code with State Amendments (California Fire Code - Part 9, Title 24 CCR).
 5. National Fire Protection Associations - National Fire Code.
- D. Nothing in these drawings and specifications is to be construed to permit work in violation thereof. Ordinances, regulations and codes are to be construed as minimum requirements.
- E. The responsibility of the Architect to conduct construction reviews of the Contractor's performance is not intended to include the adequacy of the Contractor's safety measures in, on, or near the construction site.
- F. Ventilating, refrigeration and electrical equipment and appliances are required to be approved by the Underwriters' Laboratories, Inc., or other nationally recognized testing agency and installed per the testing agency's specifications.

1.07 PERMITS, FEES AND INSPECTIONS

- A. Obtain and pay for all necessary permits, fees, assessments, complimentary drawings, required by any legally constituted public authorities having jurisdiction.

1.08 DRAWINGS AND SPECIFICATIONS

- A. The Architect's decision will be final on interpretation of the Drawings and Specifications.
- B. The Drawings and Specifications are complimentary. Any work called for on the Drawings and not mentioned in the Specifications, or vice versa, shall be performed as though fully set forth in both.
- C. Piping, ductwork and other equipment shown as existing has been taken from the Owner's drawings. Contractor shall verify exact location in field before proceeding with the work.
- D. Where codes, standards, drawings or specifications conflict, the most stringent shall prevail, unless prior approval for variance is obtained. Specific details on the drawings shall supercede the specification in the event of a conflict.
- E. Alternate support or seismic detail shall have prior approval by the Architect; and the Contractor shall obtain agency approval without any additional cost or time to the contract and without any time penalty on the work schedule.

1.09 SUBMITTALS

- A. Before starting work, the Contractor shall furnish for the approval of the Architect, Shop Drawings and Submittals with Itemized Equipment Lists, complete in all details that they proposes to install. All items shall be submitted at the same time.
- B. Submittals must be specific to this project with respect to model number, capacities, performance, etc., generic submittals will not be accepted.
- C. Variations or deviations on submitted items from that specified must be clearly tagged and / or identified
- D. Submittals shall include, but not necessarily be limited to the following which are mandatory:
 - 1. Draw Equipment Layouts to 1/4" scale, including equipment, piping accessories, and showing clearances for operating and servicing.
 - 2. Schedule of pipe, fittings, valves, with manufacturer and catalog number.
 - 3. Specialties, valves, gauges and thermometers of all types.
 - 4. Foundations, supports, hangers, inserts.
 - 5. Earthquake supports and calculations.
 - 6. Expansion loops, expansion joints, guides, and anchors.
 - 7. Insulation.
 - 8. Ventilation and air conditioning equipment, specialties and the air control systems.
 - 9. Shop fabrication drawings and installation drawings of ductwork and piping layouts. Submit for approval prior to fabrication. Drawings shall indicate dimensions from bottom of piping and ductwork to finish floor level.
 - 10. Wiring diagrams, control panel board, motor starters and controls for electrically operated equipment furnished by mechanical trades.
 - 11. Automatic control system diagrams.
 - 12. Access panels.
 - 13. Clean-outs
 - 14. Fixture carriers.
 - 15. Hangers, inserts, supports, anchors.
 - 16. Hose bibs.
 - 17. Hot water circulators.
 - 18. Pipe, fittings and specialties.

19. Pipe isolators.
20. Plumbing fixtures, fittings, trim, drains and receptors.
21. Pressure regulators.
22. Roof flashing.
23. Sleeves, escutcheons, caulking, waterproofing, fireproofing.
24. Strainers
25. Water hammer arrestors.
26. Water heating equipment.
27. Expansion joints, guides and anchors.
28. Shop fabrications drawings and calculations.
29. Special and miscellaneous products furnished under this section and not listed herein.

1.10 RECORD DRAWINGS AND MANUALS

- A. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- B. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- C. Final Record Drawings: Conform to Division 1 requirements.
- D. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- E. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- F. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.
- G. Contents: Each manual shall have an index listing the contents. Information in the manuals shall include not less than:
 1. General introductions and overall equipment description, purpose, functions and simplified theory of operation.
 2. Specifications
 3. Installation instructions, procedures, sequences, and precautions, including tolerances for level, horizontal and vertical alignment.
 4. Grouting requirements.
 5. List showing lubricants for each item of mechanical equipment and recommended lubrication intervals.
 6. Start-up and beginning operation procedures.
 7. Operational procedures.
 8. Shutdown procedures.
 9. Maintenance and calibration procedures
 10. Parts lists
 11. Name, address and telephone number of each manufacturer's local representative.

- H. Manual Submittals: Unless otherwise specified, each submittal shall include two copies of each manual, one of which will be returned to the Contractor, marked to show the required review. When approved, deliver four copies to Architect unless otherwise specified.
- I. "As-Built" drawings of ductwork and piping, including all elbows, transitions, damper and valve locations shall be provided prior to commencement of air and water balance.

1.11 QUALITY OF EQUIPMENT, MATERIALS AND WORKMANSHIP

- A. Unless otherwise specified, equipment and materials used in the installation shall be new and in perfect condition when installed. Articles provided for the same general purpose or use shall be of the same make. Workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed. Furnish the services of an experienced superintendent, who shall be constantly in charge of the work, together with all necessary journeymen, helpers and laborers required.

1.12 SEISMIC DESIGN

- A. Contractor shall be responsible for anchors and connections of mechanical work to the building structure including calculations for approval by structural engineer or for approval by inspector of record, as applies, for items or work, where approval is deferred or where alternate support or anchorage detail is proposed to prevent damage as a result of an earthquake, including manufactured equipment, the connection and integrity of shop fabricated and field fabricated materials and equipment. The anchorage of all pipes, ducts, conduits, fixtures, equipment, etc. shall withstand the lateral forces and shall accommodate calculated building displacement as required by the California Building Code, and local city/county codes. (Building equipment and connections therefore shall be designed to resist lateral seismic forces equal to 1.0 of equipment weight to working allowable stress. Cantilever posts supporting equipment shall be designed to resist lateral seismic forces equal to 0.5 of equipment weight to allowable working stress. Conform to the following:
 - 1. In accordance with Title 24, 2010 CBC Chapter 16, details shall be provided for the seismic anchorage of all mechanical and electrical equipment, anchorage details shall be based upon appropriate design calculations.
 - 2. For equipment weighing 400 pounds or more anchorage details and appropriate design calculations shall be submitted as part of the mechanical and electrical drawings. "Deferred Approval" items will not be permitted unless specifically approved by the plan check supervisor.
 - a. Exception: Attachments of equipment weighting less than 400 pounds and supported directly on the floor or roof structure, furniture, or temporary or movable equipment and equipment weighing less than 20 pounds that is supported by vibration isolation devices suspended from the roof, wall or floor, need not be detailed on the plans provided the following notes are included on the mechanical and electrical plans.
 - 3. The seismic anchorage of mechanical and electrical equipment shall conform to C.C.R. Title 24, 2010 CBC Chapter 16. Anchorage details for roof/floor-mounted equipment shall be shown on plans.

1.13 SUBSTITUTIONS AND CHANGES

- A. The design has been based on data from certain manufacturers, suitable for each application. Recommendations for alternative manufacturers are made for each product, except when "no substitutions permitted" is indicated.
- B. It is the intent of the Owner to have this project constructed with materials, products and system originally designed and specified into the project.
- C. Alternatives that may require the modification, realignment and/or adjustment of other associated components, including impact on other trades, shall be accomplished at no additional cost or time to the contract and shall have the approval of the Architect.
- D. Substitutions shall be submitted addressing all features listed in the specifications. Features that deviate from the plans and specifications shall be clearly identified including justification for deviations. Design West Engineers will review initial submittal on substitutes only. Subsequent submittals made to correct deficiencies in original submittals will be reviewed at Contractor's expense based on Design West Engineer's hourly rate for engineering services.
- E. Should the Contractor elect to propose substitutions for the Owner's interest, the substitutions shall be in compliance with Division 01.

1.14 APPROVALS

- A. The Architect will have the right to accept or reject equipment, materials, workmanship, tests and determine when the Contractor has complied with the requirements herein specified.

1.15 SELECTION AND ORDERING OF EQUIPMENT AND MATERIALS

- A. Immediately after award of the Contract and after the approval of submittals by the Architect, the Contractor shall arrange for the purchase and delivery of equipment and materials required, in ample quantities and at the proper time. He shall deliver to the Architect a complete list of equipment and materials ordered, giving descriptions, plate numbers, brochures, name of the wholesalers, date of the orders and approximate delivery dates.

1.16 LOCATIONS AND ACCESSIBILITY

- A. Drawings show pipe and ductwork diagrammatically. Conform to Drawings as closely as possible in layout work. Vary run of piping, run and shape of ductwork and make offsets during progress of work as required to meet structural and other interferences as approved by Architect. Install piping and ductwork to best suit field conditions after coordinating with other trades. Run exposed piping and ductwork parallel to, or at right angle to, building walls. Keep horizontal lines as close to bottom of structures as possible. Conform to ceiling heights established on Drawings.
- B. Install equipment in such a manner as to be readily accessible for maintenance and repairs. Install piping, ducts and conduit in such a manner as to preserve headroom, avoid obstructions and keep openings and passageways clear.
- C. Installation at valves, thermometers, gauges, cleanouts, dampers, controls, steam and water specialties, duct access doors or any other indicating equipment or specialties requiring reading, adjustment, inspection, maintenance shall be conveniently and accessible located with reference to the finished building.

- D. Where wall and ceiling access doors are required but not shown, such doors shall be furnished under other sections and as directed by the Architect. Coordinate this requirement with appropriate trade.
- E. If changes in the indicated locations or arrangements are required, they shall be made without additional charges.
- F. In an existing area, where required, remove, reinstall, reconnect or replace, etc., any existing work to accommodate new work without any additional cost to the Owner. Material shall match existing, unless otherwise specified or approved in writing by the Architect.
- G. Provide sheaves and belts if required, to Test, Adjust and Balance Agency, to allow air moving equipment to meet flow requirements specified at no additional cost to the Owner.

1.17 COORDINATION OF TRADES

- A. Contractor shall coordinate all trades in the interest of obtaining the most practical overall arrangement of equipment, piping, conduit, and ducts and to maintain maximum headroom and accessibility.
- B. No extras will be allowed for changes made necessary by interference between trades.
- C. Submit Composite Drawings in accordance with Special Conditions. Include dimensioned plans, elevations, sections and details and give complete information particularly as to the kinds and types of materials and equipment, size and location of sleeves, inserts, attachments, chases, openings, conduits, ducts, boxes, lighting, structural interferences. Coordinate these Composite Drawings and field layouts in the field for proper relationship to work of applicable trades based on field conditions. Contractor shall have competent personnel readily available for coordinating, checking, and supervision of field layouts. The procedures for submittals and resubmittals, and final distribution shall be as specified in Division 01. Do not start installation of work involved under Composite Drawings until the Architect reviews applicable submittal. Discrepancies between the Drawings and Composite Drawings shall be specifically noted and identified on the Composite Drawings. Drawings for the various trades involved shall be submitted as required and reviewed prior to preparation of Composite Drawings.
 - 1. Equipment Foundations and Bases: Furnish certified details and drawings for approval before fabrication. Furnish parts necessary for each foundation sub base and support.
 - 2. Pipe Sleeves and Inserts: Furnish and install pipe sleeves and pipe support inserts before concrete is poured.
 - 3. Roof, Wall and Floor Openings: Furnish Shop Drawings showing exact locations and sizes of openings through roofs, walls and floors.
 - 4. Concrete: Conform to Concrete Section of the Specifications.

1.18 GUARANTEES

- A. Contractor shall guarantee workmanship, equipment and materials installed under his contract for a period of not less than one (1) year from the date of Substantial Completion. Should any defects occur during this period, the Contractor shall promptly repair or replace the defective item and any other damage caused to the building free of charge to the Owner, including cost of labor and materials.
- B. Guarantee included in this section to cover:

1. Faulty or inadequate design of equipment or material installed
 2. Improper assembly or erection
 3. Defective workmanship or material
 4. Incorrect or inadequate operation or other failure
- C. He shall guarantee the complete and perfect operation of the entire system and that equipment will be supported in such a way as to be free of objectionable vibration and noise
- D. Furnish the parts and labor to replace any items found to be defective in the refrigeration equipment with the guarantee period
- E. In addition to other guarantees, furnish free maintenance for the refrigeration equipment, including replacement of refrigerant and oil, for a period of one (1) year. This shall include regular monthly maintenance and "On Call" service if required.
- F. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty to the Owner, who shall be named as beneficiary.

1.19 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Provide adequate storage facilities for equipment and materials on the site and shall make provisions to protect such materials and equipment from damage.

1.20 CLOSING-IN OF UNINSPECTED WORK

- A. Contractor shall not allow or cause any of the work, specifically ductwork and piping, to be covered up or enclosed until it has been inspected, tested, and approved by the Architect. Should any of work be covered up or enclosed before such inspection and test, he shall at his own expense, uncover the work and after it has been inspected, tested, and approved, make repairs with such materials as may be necessary to restore work to its original and proper condition.

1.21 BUILDING FOOTING CLEARANCES

- A. Under no circumstances shall pipes, ducts, or conduits penetrate footings. They shall cross below footings or through sleeves above footings. Those running parallel to footings shall have the minimum clearance from the cone of influence indicated on the Drawings or as required by Code.

1.22 DAMAGE BY LEAKS

- A. Contractor shall be responsible for all damage to any part of the premises caused by rain leaks through or around ducts or pipes, leaks or breaks in piping, equipment or fixtures furnished or installed by him for a period of one (1) year from the date of Substantial Completion.

1.23 EQUIPMENT LABELS

- A. Equipment provided under this Section shall be provided with the manufacturer's metal identification labels attached to each individual piece of equipment showing complete performance characteristics, size, model and serial number.

1.24 PRELIMINARY OPERATION

- A. Should the Owner request that any portion of the plant, apparatus, or equipment be operated for the Owner's beneficial use prior to the final completion and acceptance of the work, the Contractor shall conform to Beneficial Occupancy Provisions of the General Conditions. Such operation shall be under the supervision and direction of the Contractor. Such preliminary operation shall not be construed as an acceptance of any of the work.

1.25 MAINTAINING EXISTING SERVICES

- A. The premises and existing building at the site will be in use at the time the work of this Section is in progress. Contractor shall conduct his work so as to cause no inconvenience or danger to the personnel on the premises.
- B. He shall maintain continuity of service to the existing mechanical systems, except for designated intervals during which connections can be made. The scheduling of the shut down period shall be at a time directed by the Architect.
- C. In some instances, it may be necessary to defer work in certain areas and locations until such time as existing facilities can be relocated or rearranged by the Owner. Therefore, whenever it becomes necessary for the Contractor to perform work under this contract in areas in which the Owner's work is being performed. This contractor shall advise the Architect relative to this requirement and shall follow closely the directive issued by the Architect insofar as time and procedure are concerned. Allow Owner 72 hours prior notice.
- D. This contractor shall include in his bid all premium time to which he may be subjected for performing work in such procedure and at such time as may be necessary to cause the least interference with the function of the Owner.

1.26 ELECTRICAL WORK

- A. Coordinate with Division 26 in making the line and low voltage electrical connections and be responsible for the operation of the equipment furnished under this section.
- B. Voltage for electrical work will be included in Division 26. However, any control wiring which is required that is not shown on the control diagram shall be as described under this Section. In the event that the Contractor chooses to provide equipment that requires extra expense in the power or control wiring, he shall pay additional electrical costs.
- C. Safety switches, starters, circuit breakers, unless provided as a portion of package equipment, and the electrical connections of mechanical equipment to the electrical power service shall be provided under Division 26.
- D. Interconnecting wiring, safety switches, relays, controllers and motor starters which are integral components of packaged equipment shall be provided as an integral part of that equipment.
- E. All interconnecting power wiring and conduits shall be provided by Division 26.
- F. Control wiring shall be provided by Division 22, unless otherwise indicated on the drawings.

G. Conduit for control wiring shall be provided by Division 26.

END OF SECTION 220010

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Champion America, Inc: www.Champion-America.com.
- C. Seton Identification Products: www.seton.com/aec.

2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: Black.

2.03 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
 - 6. Ductwork and Equipment: 2-1/2 inch high letters.

- B. Stencils shall be identified as indicated below including direction of flow
 - 1. Refrigerant Suction Line - R.S.L.
 - 2. Refrigerant Liquid Line - R.L.L.
 - 3. Gravity Condensate - G.C.
 - 4. Domestic Cold Water - D.C.W.
 - 5. Domestic Hot Water - D.H.W.
 - 6. Domestic Hot Water Return - D.H.W.R.

- C. Stencil Paint: Semi-gloss enamel, colors conforming to ASME A13.1.

2.05 PIPE MARKERS

- A. Comply with ASME A13.1.

- B. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

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 plastic pipe markers in accordance with manufacturer's instructions.

- C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

- D. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

- E. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify thermostats relating to terminal boxes or valves with nameplates.
- H. Identify valves in main and branch piping with tags.

- I. Identify air terminal units and radiator valves with numbered tags.
- J. Tag automatic controls, instruments, and relays. Key to control schematic.
- K. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet 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.

END OF SECTION 220553

224000 - PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water closets.
- B. Urinals.
- C. Lavatories.
- D. Sinks.
- E. Drinking fountains.

1.02 REFERENCE STANDARDS

- A. ANSI Z124.2 - American National Standard for Plastic Shower Units; 1995.
- B. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; The American Society of Mechanical Engineers; 1997 (Reaffirmed 2002).
- C. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical Engineers; 2011.
- D. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures; The American Society of Mechanical Engineers; 2008 (R2011).
- E. ASME A112.19.2 - Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals; The American Society of Mechanical Engineers; 2008.
- F. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use); The American Society of Mechanical Engineers; 2008.
- G. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures; The American Society of Mechanical Engineers; 1994 (R2004).
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.

1.03 SUBMITTALS

- A. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Instructions: Indicate installation methods and procedures.
- C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 PRODUCTS

2.01 FLUSH VALVE WATER CLOSETS

- A. Water Closets: Vitreous china, ASME A112.19.2, floor mounted, siphon jet flush action, china bolt caps.
 - 1. Flush Volume: 1.28 gallon, maximum.
 - 2. Flush Valve: Exposed (top spud).
 - 3. Flush Operation: Manual, oscillating handle.
 - 4. Handle Height: 44 inches or less.
 - 5. Manufacturers:
 - a. American Standard Inc: www.americanstandard.com.
 - b. Sloan Valve Company: www.sloanvalve.com.
 - c. Kohler Company: www.kohler.com.
 - d. Zurn Industries, Inc: www.zurn.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
 - 1. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.
- C. Seats:
 - 1. Manufacturers:
 - a. Olsonite: www.olsonite.com.
 - b. Zurn Industries, Inc: www.zurn.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Solid white plastic, open front, extended back, self-sustaining hinge, brass bolts, without cover.

2.02 WALL HUNG URINALS

- A. Wall Hung Urinal Manufacturers:
 - 1. Zurn Industries, Inc; EcoVantage Zurn Z5799: www.zurn.com.
- B. Urinals: Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.
 - 1. Flush Volume: 0.125 gallon, maximum.
 - 2. Flush Style: Washout.
 - 3. Flush Valve: Exposed (top spud).
 - 4. Flush Operation: Sensor operated.
 - 5. Trap: Integral.
 - 6. Removable stainless steel strainer.
- C. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
 - 1. Sensor-Operated Type: Solenoid operator, battery powered, infrared sensor and over-ride push button.
 - 2. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.

2.03 LAVATORIES

- A. Lavatory Manufacturers:
 - 1. American Standard Inc: www.americanstandard.com.
 - 2. Kohler Company: www.kohler.com.
 - 3. Zurn Industries, Inc: www.zurn.com.
- B. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, ___ by ___ inch minimum, with 4 inch high back, rectangular basin with splash lip, front overflow, and soap depression.
- C. Steel Counter Top Basin:
 - 1. ASME A112.19.4M; porcelain on steel self-rimming counter top lavatory, with drillings on 4 inch centers, front overflow, soap depression, seal of putty, calking, or concealed vinyl gasket.
- D. Vitreous China Counter Top Basin:
 - 1. ASME A112.19.2; vitreous china self-rimming counter top lavatory, 20 1/4 x 17 1/2 inches with drillings on 4 inch centers, front overflow, seal of putty, calking, or concealed vinyl gasket.
- E. Supply Faucet Manufacturers:
 - 1. Chicago Faucets, a Geberit company: www.chicagofaucets.com.
 - 2. Zurn Industries, Inc: www.zurn.com.
- F. Supply Faucet:
 - ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum 0.5 gpm flow, indexed handles.
 - 1. ASME A112.18.1; chrome plated metered mixing faucet with low voltage operated solenoid operator and infrared sensor, 0.5 gpm aerator and cover plate, open grid strainer.

2.04 SINKS

- A. Sink Manufacturers:
 - 1. American Standard, Inc: www.americanstandard-us.com.
 - 2. Kohler Company: www.kohler.com.
- B. Single Compartment Bowl:
 - 1. ASME A112.19.3; 25 x 22 x 7 11/16 in outside dimensions, 19 gage thick, Type 304 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
 - a. Drain: 1-1/2 inch chromed brass drain.
- C. Double Compartment Bowl:
 - 1. ASME A112.19.3; 33 x 22 x 8 3/16 inch outside dimensions, 19 gage thick, Type 304 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
 - a. Drain: 1-1/2 inch chromed brass drain.
- D. Accessories: Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon, wheel handle stop, rigid supplies.

2.05 SHOWERS

- A. Trim:
 - 1. ASME A112.18.1; concealed shower supply with pressure balanced mixing valves, integral service stops, bent shower arm with adjustable spray ball joint shower head with maximum 1.5 flow, and escutcheon.
- B. Low-Flow Shower Head:
 - 1. ASME A112.18.1; chrome plated vandal-proof institutional head with integral wall bracket, built-in 1.5 gpm flow control.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or integral stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 05, color to match fixture.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

- A. Clean plumbing fixtures and equipment.

3.07 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

3.08 SCHEDULES

- A. Fixture Heights: Install fixtures to heights above finished floor as indicated.
 - 1. Water Closet:
 - a. Standard: 15 inches to top of bowl rim.

- b. Accessible: 18 inches to top of seat.
 - 2. Water Closet Flush Valves:
 - a. Standard: 11 inches min. above bowl rim.
 - b. Recessed: 10 inches min. above bowl rim.
 - 3. Urinal:
 - a. Standard: 22 inches to top of bowl rim.
 - b. Accessible: 17 inches to top of bowl rim.
 - 4. Lavatory:
 - a. Standard: 31 inches to top of basin rim.
 - b. Accessible: 34 inches to top of basin rim.
 - 5. Shower Heads:
 - a. Adult Male: 69.5 inches to bottom of head.
 - b. Adult Female: 64.5 inches to bottom of head.
- B. Fixture Rough-In - See sheet P-0.1

END OF SECTION 224000

SECTION 230010 - BASIC MECHANICAL REQUIREMENTS

PART 1. GENERAL

1.01 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to Division 01 - General Requirements.

1.02 DESCRIPTION

- A. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as required to complete the work of this section, except as otherwise herein specifically excluded.

1.03 WORK INCLUDED

- A. The complete Heating, Ventilating and Air Conditioning (HVAC) systems, including but not limited to these major items.
 1. Coordinate work of this Section with related trades.
 2. Verify applicable dimensions at the jobsite.
 3. Duct systems; supply, return and exhaust complete with fire dampers, combination fire-smoke dampers, and manual dampers.
 4. Diffusers and registers.
 5. Exhaust supply, return fans and air curtains.
 6. Furnishing and installation of miscellaneous hangers, supports, sleeves, inserts, anchors and other auxiliary equipment for systems under this Division.
 7. Duct lining and insulation.
 8. Water piping systems inside and outside the building, including connections to fixtures, equipment, water meters and vaults; pressure regulating stations, backflow preventers.
 9. Installation and connection of Owner furnished equipment.
 10. Water heating systems, including water heating equipment, circulating pumps, connections.
 11. Shop drawings.
 12. Equipment identification.
 13. Equipment and systems adjustments and balancing.
 14. Air, water and gas systems testing, adjusting and balancing.
 15. Written operating and maintenance instructions.
 16. Record drawings.
 17. Guarantee

1.04 WORK SPECIFIED ELSEWHERE

- A. Concrete, Architectural Sheet Metal, Door and Exterior Wall Louvers, Painting and Electrical.

1.05 SITE INSPECTION

- A. Contractor shall familiarize himself with the conditions at the site. No allowance will be made subsequently for any error through negligence in observing the site conditions. Contractor shall observe and make cost allowance for any mechanical and/or electrical items that must be relocated to accommodate the installation or servicing of any item covered under this contract.

1.06 ORDINANCES, REGULATIONS AND CODES

- A. References to Technical Societies, Trade Organizations, Governmental Agencies is made in Division 15 in accordance with the following abbreviations.
1. AFI - Air Filter Institute
 2. AMCA - Air Moving & Conditioning Association
 3. ARI - Air Conditioning & Refrigeration Institute
 4. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
 5. ASME - American Society of Mechanical Engineers
 6. ASTM - American Society of Testing Materials
 7. AWSC - American Welding Society Code
 8. ANSI - American National Standards Institute
 9. CBC - California Building Code
 10. CCR - California Code of Regulations
 11. CEC - California Electrical Code
 12. CFC - California Fire Codes
 13. CMC - California Mechanical Code
 14. CPC - California Plumbing Code
 15. FIA - Factory Insurance Association
 16. NAFM - National Association of Fan Manufacturers
 17. NEMA - National Electrical Manufacturer's Association
 18. NFPA - National Fire Protection Association
 19. ORS - Office of Regulatory Services
 20. SCAQMD - South Coast Air Quality Management District
 21. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
 22. UFC - Uniform Fire Code
 23. UL - Underwriter's Laboratories
 24. UPC - Uniform Plumbing Code
- B. Requirements of Regulatory Agencies: Materials and installation shall comply with applicable local, state, and national codes and ordinances. Rulings and interpretations of the enforcing agencies shall be considered as part of the local codes. No extras will be permitted for furnishing items required by the local codes but not specified or shown on the drawings.
- C. Codes and Standards:
1. UBC and California Amendments (California Building Code - Part 2, Title 24, CCR).
 2. UMC and California Amendments (California Mechanical Code - Part 4, Title 24 CCR).
 3. UPC and California Amendments (California Plumbing Code - Part 5, Title 24 CCR).
 4. Uniform Fire Code with State Amendments (California Fire Code - Part 9, Title 24 CCR).
 5. National Fire Protection Associations - National Fire Code.
- D. Nothing in these drawings and specifications is to be construed to permit work in violation thereof. Ordinances, regulations and codes are to be construed as minimum requirements.
- E. The responsibility of the Architect to conduct construction reviews of the Contractor's performance is not intended to include the adequacy of the Contractor's safety measures in, on, or near the construction site.
- F. Ventilating, refrigeration and electrical equipment and appliances are required to be approved by the Underwriters' Laboratories, Inc., or other nationally recognized testing agency and installed per the testing agency's specifications.

1.07 PERMITS, FEES AND INSPECTIONS

- A. Obtain and pay for all necessary permits, fees, assessments, complimentary drawings, required by any legally constituted public authorities having jurisdiction.

1.08 DRAWINGS AND SPECIFICATIONS

- A. The Architect's decision will be final on interpretation of the Drawings and Specifications.
- B. The Drawings and Specifications are complimentary. Any work called for on the Drawings and not mentioned in the Specifications, or vice versa, shall be performed as though fully set forth in both.
- C. Piping, ductwork and other equipment shown as existing has been taken from the Owner's drawings. Contractor shall verify exact location in field before proceeding with the work.
- D. Where codes, standards, drawings or specifications conflict, the most stringent shall prevail, unless prior approval for variance is obtained. Specific details on the drawings shall supercede the specification in the event of a conflict.
- E. Alternate support or seismic detail shall have prior approval by the Architect; and the Contractor shall obtain agency approval without any additional cost or time to the contract and without any time penalty on the work schedule.

1.09 SUBMITTALS

- A. Before starting work, the Contractor shall furnish for the approval of the Architect, Shop Drawings and Submittals with Itemized Equipment Lists, complete in all details that they proposes to install. All items shall be submitted at the same time.
- B. Submittals must be specific to this project with respect to model number, capacities, performance, etc., generic submittals will not be accepted.
- C. Variations or deviations on submitted items from that specified must be clearly tagged and / or identified
- D. Submittals shall include, but not necessarily be limited to the following which are mandatory:
 - 1. Draw Equipment Layouts to 1/4" scale, including equipment, piping accessories, and showing clearances for operating and servicing.
 - 2. Pumps, pump characteristic curves.
 - 3. Schedule of pipe, fittings, valves, with manufacturer and catalog number.
 - 4. Specialties, valves, gauges and thermometers of all types.
 - 5. Foundations, supports, hangers, inserts.
 - 6. Earthquake supports and calculations.
 - 7. Expansion loops, expansion joints, guides, and anchors.
 - 8. Insulation.
 - 9. Ventilation and air conditioning equipment, specialties and the air control systems.
 - 10. Fans, fan characteristic curves, fan tests.
 - 11. Dampers, louvers, grilles, registers, diffusers.
 - 12. Shop fabrication drawings and installation drawings of ductwork and piping layouts. Submit for approval prior to fabrication. Drawings shall indicate dimensions from bottom of piping and ductwork to finish floor level.
 - 13. Wiring diagrams, control panel board, motor starters and controls for electrically operated equipment furnished by mechanical trades.
 - 14. Automatic control system diagrams.
 - 15. Underground and above ground tanks, accessories.
 - 16. Exhaust, supply and return fans.
 - 17. Access panels.
 - 18. Hangers, inserts, supports, anchors.
 - 19. Hot water circulators.
 - 20. Pipe, fittings and specialties.
 - 21. Pipe isolators.
 - 22. Sleeves, escutcheons, caulking, waterproofing, fireproofing.
 - 23. Expansion joints, guides and anchors.
 - 24. Shop fabrications drawings and calculations.

25. Special and miscellaneous products furnished under this section and not listed herein.

1.10 RECORD DRAWINGS AND MANUALS

- A. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- B. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- C. Final Record Drawings: Conform to Division 01 requirements.
- D. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- E. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- F. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.
- G. Contents: Each manual shall have an index listing the contents. Information in the manuals shall include not less than:
 - 1. General introductions and overall equipment description, purpose, functions and simplified theory of operation.
 - 2. Specifications
 - 3. Installation instructions, procedures, sequences, and precautions, including tolerances for level, horizontal and vertical alignment.
 - 4. Grouting requirements.
 - 5. List showing lubricants for each item of mechanical equipment and recommended lubrication intervals.
 - 6. Start-up and beginning operation procedures.
 - 7. Operational procedures.
 - 8. Shutdown procedures.
 - 9. Maintenance and calibration procedures
 - 10. Parts lists
 - 11. Name, address and telephone number of each manufacturer's local representative.
- H. Manual Submittals: Unless otherwise specified, each submittal shall include two copies of each manual, one of which will be returned to the Contractor, marked to show the required review. When approved, deliver four copies to Architect unless otherwise specified.
- I. "As-Built" drawings of ductwork and piping, including all elbows, transitions, damper and valve locations shall be provided prior to commencement of air and water balance.

1.11 QUALITY OF EQUIPMENT, MATERIALS AND WORKMANSHIP

- A. Unless otherwise specified, equipment and materials used in the installation shall be new and in perfect condition when installed. Articles provided for the same general purpose or use shall be of the same make. Workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed. Furnish the services of an experienced superintendent, who shall be constantly in charge of the work, together with all necessary journeymen, helpers and laborers required.

1.12 SEISMIC DESIGN

- A. Contractor shall be responsible for anchors and connections of mechanical work to the building structure including calculations for approval by structural engineer or for approval by inspector of record, as applies, for items or work, where approval is deferred or where alternate support or anchorage detail is proposed to prevent damage as a result of an earthquake, including manufactured equipment, the connection and integrity of shop fabricated and field fabricated materials and equipment. The anchorage of all pipes, ducts, conduits, fixtures, equipment, etc. shall withstand the lateral forces and shall accommodate calculated building displacement as required by the California Building Code, and local city/county codes. (Building equipment and connections therefore shall be designed to resist lateral seismic forces equal to 1.0 of equipment weight to working allowable stress. Cantilever posts supporting equipment shall be designed to resist lateral seismic forces equal to 0.5 of equipment weight to allowable working stress. Conform to the following:
1. In accordance with Title 24, 2010 CBC Chapter 16, details shall be provided for the seismic anchorage of all mechanical and electrical equipment, anchorage details shall be based upon appropriate design calculations.
 2. For equipment weighing 400 pounds or more anchorage details and appropriate design calculations shall be submitted as part of the mechanical and electrical drawings. "Deferred Approval" items will not be permitted unless specifically approved by the plan check supervisor.
 - a. Exception: Attachments of equipment weighting less than 400 pounds and supported directly on the floor or roof structure, furniture, or temporary or movable equipment and equipment weighing less than 20 pounds that is supported by vibration isolation devices suspended from the roof, wall or floor, need not be detailed on the plans provided the following notes are included on the mechanical and electrical plans.
 3. The seismic anchorage of mechanical and electrical equipment shall conform to C.C.R. Title 24, 2010 CBC Chapter 16. Anchorage details for roof/floor-mounted equipment shall be shown on plans.

1.13 SUBSTITUTIONS AND CHANGES

- A. The design has been based on data from certain manufacturers, suitable for each application. Recommendations for alternative manufacturers are made for each product, except when "no substitutions permitted" is indicated.
- B. It is the intent of the Owner to have this project constructed with materials, products and system originally designed and specified into the project.
- C. Alternatives that may require the modification, realignment and/or adjustment of other associated components, including impact on other trades, shall be accomplished at no additional cost or time to the contract and shall have the approval of the Architect.
- D. Substitutions shall be submitted addressing all features listed in the specifications. Features that deviate from the plans and specifications shall be clearly identified including justification for deviations. Design West Engineers will review initial submittal on substitutes only. Subsequent submittals made to correct deficiencies in original submittals will be reviewed at Contractor's expense based on Design West Engineer's hourly rate for engineering services.
- E. Should the Contractor elect to propose substitutions for the Owner's interest, the substitutions shall be in compliance with Division 01.

1.14 APPROVALS

- A. The Architect will have the right to accept or reject equipment, materials, workmanship, tests and determine when the Contractor has complied with the requirements herein specified.

1.15 SELECTION AND ORDERING OF EQUIPMENT AND MATERIALS

- A. Immediately after award of the Contract and after the approval of submittals by the Architect, the Contractor shall arrange for the purchase and delivery of equipment and materials required, in ample quantities and at the proper time. He shall deliver to the Architect a complete list of equipment and materials ordered, giving descriptions, plate numbers, brochures, name of the wholesalers, date of the orders and approximate delivery dates.

1.16 LOCATIONS AND ACCESSIBILITY

- A. Drawings show pipe and ductwork diagrammatically. Conform to Drawings as closely as possible in layout work. Vary run of piping, run and shape of ductwork and make offsets during progress of work as required to meet structural and other interferences as approved by Architect. Install piping and ductwork to best suit field conditions after coordinating with other trades. Run exposed piping and ductwork parallel to, or at right angle to, building walls. Keep horizontal lines as close to bottom of structures as possible. Conform to ceiling heights established on Drawings.
- B. Install equipment in such a manner as to be readily accessible for maintenance and repairs. Install piping, ducts and conduit in such a manner as to preserve headroom, avoid obstructions and keep openings and passageways clear.
- C. Installation at valves, thermometers, gauges, cleanouts, dampers, controls, steam and water specialties, duct access doors or any other indicating equipment or specialties requiring reading, adjustment, inspection, maintenance shall be conveniently and accessible located with reference to the finished building.
- D. Where wall and ceiling access doors are required but not shown, such doors shall be furnished under other sections and as directed by the Architect. Coordinate this requirement with appropriate trade.
- E. If changes in the indicated locations or arrangements are required, they shall be made without additional charges.
- F. In an existing area, where required, remove, reinstall, reconnect or replace, etc., any existing work to accommodate new work without any additional cost to the Owner. Material shall match existing, unless otherwise specified or approved in writing by the Architect.
- G. Provide sheaves and belts if required, to Test, Adjust and Balance Agency, to allow air moving equipment to meet flow requirements specified at no additional cost to the Owner.

1.17 COORDINATION OF TRADES

- A. Contractor shall coordinate all trades in the interest of obtaining the most practical overall arrangement of equipment, piping, conduit, and ducts and to maintain maximum headroom and accessibility.
- B. No extras will be allowed for changes made necessary by interference between trades.
- C. Submit Composite Drawings in accordance with Special Conditions. Include dimensioned plans, elevations, sections and details and give complete information particularly as to the kinds and types of materials and equipment, size and location of sleeves, inserts, attachments, chases, openings, conduits, ducts, boxes, lighting, structural interferences. Coordinate these Composite Drawings and field layouts in the field for proper relationship to work of applicable trades based on field conditions. Contractor shall have competent personnel readily available for coordinating, checking, and supervision of field layouts. The procedures for submittals and resubmittals, and final distribution shall be as specified in Division 01. Do not start installation of work involved under Composite Drawings until the Architect reviews applicable submittal. Discrepancies between the Drawings and Composite Drawings shall be specifically noted and identified on the Composite Drawings. Drawings for the various trades involved shall be submitted as required and reviewed prior to preparation of Composite Drawings.

1. Equipment Foundations and Bases: Furnish certified details and drawings for approval before fabrication. Furnish parts necessary for each foundation sub base and support.
2. Pipe Sleeves and Inserts: Furnish and install pipe sleeves and pipe support inserts before concrete is poured.
3. Roof, Wall and Floor Openings: Furnish Shop Drawings showing exact locations and sizes of openings through roofs, walls and floors.
4. Concrete: Conform to Concrete Section of the Specifications.

1.18 GUARANTEES

- A. Contractor shall guarantee workmanship, equipment and materials installed under his contract for a period of not less than one (1) year from the date of Substantial Completion. Should any defects occur during this period, the Contractor shall promptly repair or replace the defective item and any other damage caused to the building free of charge to the Owner, including cost of labor and materials.
- B. Guarantee included in this section to cover:
 1. Faulty or inadequate design of equipment or material installed
 2. Improper assembly or erection
 3. Defective workmanship or material
 4. Incorrect or inadequate operation or other failure
- C. He shall guarantee the complete and perfect operation of the entire system and that equipment will be supported in such a way as to be free of objectionable vibration and noise
- D. Furnish the parts and labor to replace any items found to be defective in the refrigeration equipment with the guarantee period
- E. In addition to other guarantees, furnish free maintenance for the refrigeration equipment, including replacement of refrigerant and oil, for a period of one (1) year. This shall include regular monthly maintenance and "On Call" service if required.
- F. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty to the Owner, who shall be named as beneficiary.

1.19 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Provide adequate storage facilities for equipment and materials on the site and shall make provisions to protect such materials and equipment from damage.

1.20 CLOSING-IN OF UNINSPECTED WORK

- A. Contractor shall not allow or cause any of the work, specifically ductwork and piping, to be covered up or enclosed until it has been inspected, tested, and approved by the Architect. Should any of work be covered up or enclosed before such inspection and test, he shall at his own expense, uncover the work and after it has been inspected, tested, and approved, make repairs with such materials as may be necessary to restore work to its original and proper condition.

1.21 BUILDING FOOTING CLEARANCES

- A. Under no circumstances shall pipes, ducts, or conduits penetrate footings. They shall cross below footings or through sleeves above footings. Those running parallel to footings shall have the minimum clearance from the cone of influence indicated on the Drawings or as required by Code.

1.22 DAMAGE BY LEAKS

- A. Contractor shall be responsible for all damage to any part of the premises caused by rain leaks through or around ducts or pipes, leaks or breaks in piping, equipment or fixtures furnished or installed by him for a period of one (1) year from the date of Substantial Completion.

1.23 EQUIPMENT LABELS

- A. Equipment provided under this Section shall be provided with the manufacturer's metal identification labels attached to each individual piece of equipment showing complete performance characteristics, size, model and serial number.

1.24 PRELIMINARY OPERATION

- A. Should the Owner request that any portion of the plant, apparatus, or equipment be operated for the Owner's beneficial use prior to the final completion and acceptance of the work, the Contractor shall conform to Beneficial Occupancy Provisions of the General Conditions. Such operation shall be under the supervision and direction of the Contractor. Such preliminary operation shall not be construed as an acceptance of any of the work.

1.25 MAINTAINING EXISTING SERVICES

- A. The premises and existing building at the site will be in use at the time the work of this Section is in progress. Contractor shall conduct his work so as to cause no inconvenience or danger to the personnel on the premises.
- B. He shall maintain continuity of service to the existing mechanical systems, except for designated intervals during which connections can be made. The scheduling of the shut down period shall be at a time directed by the Architect.
- C. In some instances, it may be necessary to defer work in certain areas and locations until such time as existing facilities can be relocated or rearranged by the Owner. Therefore, whenever it becomes necessary for the Contractor to perform work under this contract in areas in which the Owner's work is being performed. This contractor shall advise the Architect relative to this requirement and shall follow closely the directive issued by the Architect insofar as time and procedure are concerned. Allow Owner 72 hours prior notice.
- D. This contractor shall include in his bid all premium time to which he may be subjected for performing work in such procedure and at such time as may be necessary to cause the least interference with the function of the Owner.

1.26 ELECTRICAL WORK

- A. Coordinate with Division 16 in making the line and low voltage electrical connections and be responsible for the operation of the equipment furnished under this section.
- B. Voltage for electrical work will be included in Division 26. However, any control wiring which is required that is not shown on the control diagram shall be as described under this Section. In the event that the Contractor chooses to provide equipment that requires extra expense in the power or control wiring, he shall pay additional electrical costs.
- C. Safety switches, starters, circuit breakers, unless provided as a portion of package equipment, and the electrical connections of mechanical equipment to the electrical power service shall be provided under Division 26.
- D. Interconnecting wiring, safety switches, relays, controllers and motor starters which are integral components of packaged equipment shall be provided as an integral part of that equipment.
- E. All interconnecting power wiring and conduits shall be provided by Division 26.

- F. Control wiring shall be provided by Division 23, unless otherwise indicated on the drawings.
- G. Conduit for control wiring shall be provided by Division 26.

END OF SECTION 230010

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.
- C. Commissioning activities.

1.02 REFERENCE STANDARDS

- A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.
- B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 1988, with 1997 Errata.
- C. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.03 SUBMITTALS

- A. The contractor shall procure the services of an independent Air Balance and Testing Agency, approved by the Engineer, which specializes in the balancing and testing of heating, ventilating, and air conditioning systems. The independent agency shall be certified and in good standing with the AABC.
- B. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit to the Commissioning Authority.
 - 3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 4. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with Architect and other installers to sufficiently understand the design intent for each system.
 - 5. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Expected problems and solutions, etc.
 - g. Criteria for using air flow straighteners or relocating flow stations and sensors.
 - h. Details of how TOTAL flow will be determined; for example:

- 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
 - k. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
 - l. Method of checking building static and exhaust fan and/or relief damper capacity.
 - m. Time schedule for deferred or seasonal TAB work, if specified.
 - n. False loading of systems to complete TAB work, if specified.
 - o. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - p. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - q. Procedures for formal progress reports, including scope and frequency.
 - r. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Field Logs: Submit at least twice a week to Commissioning Authority.
- E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- F. Progress Reports.
- G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 1. Submit to the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
 7. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Architect.
 - g. Project Engineer.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC MN-1, AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
 - 4. Maintain at least one copy of the standard to be used at project site at all times.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Certified by the following:
 - a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.04 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.05 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- G. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- H. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- I. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- J. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.06 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.

- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

3.07 COMMISSIONING

- A. Perform prerequisites prior to starting commissioning activities.
- B. Fill out Prefunctional Checklists for:
 - 1. Air side systems.
- C. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- D. Re-check a random sample equivalent to 25 percent of the final TAB report data as directed by Commissioning Authority.
 - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
 - 2. Use the same test instruments as used in the original TAB work.
 - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - 4. For purposes of re-check, failure is defined as follows:
 - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
 - c. Temperatures: Deviation of more than one degree F.
 - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
 - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
 - 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- E. In the presence of the Commissioning Authority, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
 - 3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil

having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.08 SCOPE

- A. Test, adjust, and balance the following:
 - 1. HVAC Pumps
 - 2. Forced Air Furnaces
 - 3. Packaged Roof Top Heating/Cooling Units
 - 4. Packaged Terminal Air Conditioning Units
 - 5. Computer Room Air Conditioning Units
 - 6. Terminal Heat Transfer Units
 - 7. Fans

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Duct Liner.
- C. Insulation jackets.

1.02 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- D. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2011.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2010.
- F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2012.
- G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2012.
- H. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- I. SMACNA (DCS) - HVAC Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association; 2005.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. Johns Manville Corporation: www.jm.com.
 - 2. Owens Corning Corp: www.owenscorning.com.
 - 3. CertainTeed Corporation: www.certainteed.com.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value: 0.25 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Governing body regulation values or as listed on the drawings as more stringent than 'K' value above, insulation value shall be superceeded with said value
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. Johns Manville Corporation: www.jm.com.
 - 2. Owens Corning Corp: www.owenscorning.com.
 - 3. CertainTeed Corporation: www.certainteed.com.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. 'K' value: .16 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Governing body regulation values or as listed on the drawings as more stringent than 'K' value above, insulation value shall be superceeded with said value
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

2.04 JACKETS

- A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

- B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M).
 - 1. Thickness: 0.016 inch sheet.

2.05 DUCT LINER

- A. Manufacturers:
 - 1. Johns Manville Corporation: www.jm.com.
 - 2. Owens Corning Corp: www.owenscorning.com.
 - 3. CertainTeed Corporation: www.certainteed.com.
- B. Insulation: Incombustible glass fiber complying with ASTM C 1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer or acrylic polymer shown to be fungus and bacteria resistant by testing to ASTM G 21.
 - 1. Apparent Thermal Conductivity: Maximum of .24 at 75 degrees F.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that ducts have been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated ducts conveying air below ambient temperature:
 - 1. Finish with tape and vapor barrier jacket.
 - 2. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
- D. Insulated ducts conveying air above ambient temperature:
- E. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.
- F. External Duct Insulation Application:
 - 1. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 - 2. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
- G. Duct and Plenum Liner Application:
 - 1. Secure insulation with mechanical liner fasteners. Refer to SMACNA HVAC Duct Construction Standards for spacing.
 - 2. Seal and smooth joints. Seal and coat transverse joints.
 - 3. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.03 SCHEDULES - INSULATE DUCTS PER TITLE-24 REQUIREMENTS

END OF SECTION 230713

SECTION 230900 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls. This section includes:
 - 1. Control equipment.
 - 2. Software.
 - 3. Sensors.
 - 4. Control Instruments.
 - 5. Controllers.
 - 6. Wiring and conduit in connection with HVAC Instrumentation and Controls in accordance with Division 26.
 - 7. Power supply to HVAC Instrumentation and Controls unless otherwise specified under Division 26.
 - 8. Duct smoke detectors unless otherwise specified under Fire Alarm System.
 - 9. Commissioning of HVAC Instrumentation and Controls.
 - 10. Trending and coordination with other trades for Commissioning of HVAC Systems.
- B. Related Divisions include the following:
 - 1. Division 21: Fire Suppression
 - 2. Division 22: Plumbing
 - 3. Division 23: Heating, Ventilating and Air Conditioning
 - 4. Division 25: Integrated Automation Systems
 - 5. Division 26: Electrical
 - 6. Division 27: Communication
 - 7. Division 28: Electrical Safety and Security

1.03 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. LAN: Local area network.
- C. MS/TP: Master-slave/token-passing.
- D. BAS: Building Automation System
- E. BACnet: Building Automation and Control Network Protocol by ASHRAE
- F. BTL: BACnet Test Laboratory
- G. PIO: Proportional Plus Integral Plus Derivative
- H. PICS: Protocol Implementation Conformance Statement
- I. RTD: Resistance Temperature Detection
- J. BIBBS: BACnet Interoperability Building Blocks
- K. XML: Extensible Mark-up Language
- L. OBIX: Open Building Information Exchange

- M. SOAP: Simple Object Access Protocol

1.04 REFERENCES

- A. NFPA 90 - Installation of Air Conditioning and Ventilating Systems.
- B. UL 864 - Control Units for Fire Protective Signaling Systems.
- C. UL 916 - Energy Management.
- D. NFPA 91A - Recommended practice for smoke control systems.
- E. ADA - Americans with Disabilities Act.
- F. UL 508A - Manufacturer listed control panel.
- G. EIA/TIA-568 - Commercial Building Wiring Standard.
- H. ASHRAE - American Society of Heating Refrigerating and Air Conditioning Engineers
- I. ANSI/ASHRAE Standard 135-2008 BACnet
- J. EMC Directive 89/336/EEC (European CE Mark)

1.05 SYSTEM DESCRIPTION

- A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- B. A distributed control system, complete with all software and hardware functions, shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2008, BACnet. This system is to control mechanical equipment specified using native BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems shall not be acceptable and are specifically prohibited.
- C. The system shall provide capability through web services. The web services shall perform through the Niagara AX Platform. Refer to Division 25.
- D. Control system includes coordination with other trades from conception to completion of project to allow for a Commissioning and Operating HVAC Control System.
- E. Control System includes wiring and conduit in connection with HVAC Instrumentation and Controls.
- F. Control System includes the electrical power supply to HVAC Instrumentation and Controls, unless otherwise specified under Division 26. Coordinate with Electrical Contractor and other trades. Provide a complete and operational control system.

1.06 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display Time: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh Time: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
 - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
 - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
 - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
 - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.

7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
9. The requirements here are state for verification and measurement purposed and do not reduce the accuracy requirements of sensors and other components specified.
 - a. Water Temperature: Plus or minus 1 deg F.
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Dew Point Temperature: Plus or minus 3 deg F.
 - e. Relative Humidity: Plus or minus 5 percent.
 - f. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - g. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - h. Air Pressure (Space): Plus or minus 0.01-inch wg.
 - i. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
 - j. Carbon Monoxide: Plus or minus 5 percent of reading.
 - k. Carbon Dioxide: Plus or minus 50 ppm.

1.07 SUBMITTALS

- A. Provide a complete and comprehensive submittal package. Partial submittals shall not be accepted. Upon completion submit all compliance data and project record documents.
- B. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 1. Each control device labeled with setting or adjustable range of control.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Schematic flow diagrams showing the systems for fans, pumps, coils, dampers, valves, and control devices.
 2. Wiring diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring. Indicate LAN/ BACnet and or Gateway connections.
 3. Color scheme for control wiring.
 4. Details of control panel faces, including controls, instruments, and labeling.
 5. Written description of sequence of operation.
 6. Schedule of dampers including leakage and flow characteristics.
 7. Schedule of valves including leakage and flow characteristics.
 8. DDC System Architecture including number and location of Tridium JACEs, controllers, computer and other hardware components.
 9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 10. Detailed point list.
 11. BACnet PICS statements for each submitted controller
 12. A floor plan indicating the actual location of room temperature sensor for coordination with furniture layout.
 13. Program flow charting.
 14. A floor plan indicating location of concealed duct static pressure sensors used for controlling air moving equipment.
- D. Installing company qualifications.
- E. Manufacturer qualifications.
- F. Commissioning of building automation system.

- G. Installation verification of building automation system.
- H. A letter of approval signed by the project commissioning authority indicating acceptance of sequence of operation.
- I. Samples: Of each type of room temperature cover.
- J. Software and Firmware Operational Documentation: Include the following:
 - 1 Software operating and upgrade manuals.
 - 2 Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3 Device address list.
 - 4 Printout of software application and graphic screens.
 - 5 Software license required by and installed for DDC workstations and control systems.
 - 6 Domain, Subnet, & Channel ID's.
- K. Software Upgrade Kit: For Owner to use in modifying software to suit future system revisions or monitoring and control revisions.
- L. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- M. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. Include the following:
 - 1 Maintenance instructions and lists of spare parts for each type of control device.
 - 2 Interconnection wiring diagrams with identified and numbered system components and devices.
 - 3 Keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 4 Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 5 Calibration records and list of set points.
- N. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences. Provide an updated floor plan indication the actual installed location of room temperature sensors and duct static pressure sensors.
- O. Seventy-two (72) hour trend data.
- P. HVAC Instrumentation and Controls training program.

1.08 QUALITY ASSURANCE

- A. Installing Company Qualifications:
 - 1 Five years of experience in installation of similar systems for similar projects. .
 - 2 A Building Automation Service Department within Riverside County with a 2-hour minimum response time for emergency service.
 - 3 Authorized Factory Representative for submitted BACnet controls product.

B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems and with a record of successful in-service performance. The manufacturer's DDC control hardware and software shall have BACnet conformance approval from the BACnet Test Laboratory. The control system architecture shall consist of the components of one manufacturer regularly engaged in the production of open control systems and shall be the manufacturer's latest standard of design at the time of the bid.

C. Control Engineer Qualifications: A control Engineer shall oversee the design and installation of the DDC system. The Control Engineer shall have a minimum of five (5) years experience with the installing company at an equal level of responsibility. The Control Engineer shall have completed factory training for certification for the design, installation, start-up, and

commissioning of the DDC components to be installed. The Control Engineer shall have experience in completing a minimum of two projects of similar size with the type of DDC system specified for this project. Removal or replacement of Control Engineer shall be subject to the owner's approval.

- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. All DDC controllers for this project shall be manufactured by single manufacturer. A mixture of DDC controllers by various manufacturers shall not be allowed. All DDC controllers, building controllers and application controllers shall communicate via BACnet LAN.
- E. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- F. Comply with ASHRAE 135 for DDC system control components.
- G. Control panels and cabinets installed in this project shall be UL 508A listed as a complete assembly. All electronic components and devices shall be enclosed in NEMA rated enclosures.
- H. All system levels shall be compliant with the BACnet Standard 135-2008. Upon completion of commissioning process and prior to acceptance, contractor shall provide a protocol analyzer and demonstrate that all system components that communicate within the system utilize the BACnet protocol. Contractor may at their expense hire a qualified, independently registered engineer to perform test. Any components that do not fully comply with the BACnet standard shall be replaced until entire system architecture is re-tested and compliant. Conflict resolution shall be submitted to BTL (www.BACnetassociation.org) at contractor's expense and BTL determination shall be final.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

- A. Coordinate location of room temperature sensors, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 21: Fire Suppression to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- D. Coordinate chiller control network requirements with chiller control requirements and control system components provided with the chiller equipment.
- E. Coordinate equipment to achieve compatibility with motor starters and annunciation devices.
- F. Coordinate with Division 26 for Electrical Power Supply to Control Equipment and Device. Unless otherwise specified under Division 26, provide and install all the electrical wiring/conduit and components for a complete and operational control system.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Room Temperature Sensor: Provide five for each unique type.
 - 2. Zone Controllers: Provide five for each unique type.
- B. Replacement Materials: One replacement relay mechanism for each unique damper motor, valve motor, controller, and sensor.

1.12 WARRANTY

- A. The system shall include all hardware and software components warranty for a period of one year following the substantial completion date. Provide a five-year warranty for all actuators.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, installing company qualifications, and manufacturer's qualifications, provide products by the following. The manufacturer shall provide DDC control hardware and software with BACnet conformance approvals from the BACnet Test Laboratory.
 - 1. Electric, Electronic, and DDC Systems:
 - a. Alerton, BACnet Systems
 - b. DisTech, BACnet Systems
 - c. Honeywell, BACnet Systems
 - d. Johnson Controls Inc., Metasys System Extended Architecture

2.02 DDC EQUIPMENT AND SOFTWARE

- A. Operator Workstation
 - 1. Network management tools shall be based upon Tridium Niagara AX Framework technology as developed by the Tridium Corporation. All tools and hardware provided shall comply with the current release version of the AX Niagara Framework platform. The supplied computer software shall employ object-oriented technology for representation of all data and control devices within the system. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135 BACnet technology, and other open communication protocols in one open, interoperable system. Provide open Vykon Niagara AX Java application control engines (JACE's). Private label or proprietary JACEs shall not be accepted.
- B. Workstation Hardware: Refer to Division 25 Integrated Automation, section 250000 Facility Management and Control System.
- C. Graphics software: The graphics shall reside on the Niagara AX platform. Refer to Division 25 Integrated Automation, section 250000 Facility Management and Control System.
- D. DDC Controllers
 - 1. Communication from JACE's to DDC Controllers shall be via BACnet. Building controller shall incorporate as a minimum, the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz), master slave token passing (MS/TP) LANs, a point-to-point (PTP - RS-232) connection and modem.
 - 2. Each MS/TP LAN shall be software configurable from 9.6 to 76.8Kbps.
 - 3. Building controller shall be capable of providing global control strategies for the system based on information from any objects in the system regardless if the object is directly monitored by the controller or by another controller. The program that implements these strategies shall be completely flexible and user definable.
 - 4. Programming shall be object-oriented using control function blocks, supporting DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be resident on workstation and the same tool used for all controllers.

5. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's workstation or field computer.
 6. Building controller shall provide battery-backed real-time (hardware) clock functions.
 7. Controller shall have a memory needed to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 2 years (cumulative).
- E. Application-Specific controllers:
1. Provide one native BACnet application specific controller for each piece of unitary mechanical equipment that adequately covers all objects listed. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.
 2. Zone damper: Actuators shall be electronic with a means for lockable manual override.
 3. Provide a metal NEMA 2 enclosure for actuator assembly of the zone controllers.
 4. Provide a metal NEMA 2 enclosure for all electronic components of zone controller.
- F. Software Capabilities: Update to latest version of software at Project completion. Include and implement the following capabilities from the control units:
1. Units of Measure: Inch-pound and SI (metric).
 2. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, DDC with fine tuning, and trend logging.
 3. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 4. Programming Application Features: Include trend point, alarm messages, weekly scheduling, and interlocking.
 5. Paging: Provide the means of automatic alpha numeric paging of personnel for user defined control system requirements.

2.03 CONTROL PANELS

- A. Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels. Provide UL 508A listed panels as a complete assembly.
1. Fabricate panels of 0.06-inch- thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
 2. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.
 3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.
 4. Graphics: Color-coded graphic, laminated-plastic displays on doors, schematically showing system being controlled, with protective, clear plastic sheet bonded to entire door.
 5. Provide one uninterrupted power supply for each main control panel.
- B. Alarm Panels: Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted in hinged-cover enclosure.
1. Alarm Condition: Indicating light flashes and horn sounds.
 2. Acknowledge Switch: Horn is silent and indicating light is steady.
 3. Second Alarm: Horn sounds and indicating light is steady.
 4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
 5. Contacts in alarm panel allow remote monitoring by independent alarm company.
- C. Provide one external Uninterrupted Power Supply (UPS) in NEMA 1 enclosure for every DDC Control Panel. Enclosures on the roof shall be NEMA 12R.

2.04 SENSORS AND COMMUNICATION DEVICES

- A. Electronic Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
1. Thermistor Temperature Sensors (Thermistor):
 - a. Accuracy: Plus or minus 0.5 deg F at calibration point.
 - b. Wire: Twisted, shielded-pair cable.
 - c. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 2. Resistance Temperature Detectors (RTD): Platinum.
 - a. Accuracy: Plus or minus 0.2 percent at calibration point.
 - b. Wire: Twisted, shielded-pair cable.
 - c. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 - d. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Duct Static-Pressure Range: 0 to 5 inches wg.
 4. Turbine Flow Insertion Tube Meters: Provide Dual Turbine Flow Insertion Tube Flow Meter with digital display of flow rate, total and 4-20 mA signal in NEMA 4X enclosure.
 - a. Accuracy: + 0.5% of reading at calibrated velocity.
 - b. Output: 4 to 20 mA.
 - c. Material rated for type and temperature of fluid.
 5. Liquid Pressure Transmitters: Provide Liquid Pressure Sensors with accuracy of + 1% operating environment or -40 degrees F to 260 degrees F with output signal of 4-20 mA.
 6. Current Sensing Relays: Solid State AC switch with internal current transformer. The switch shall operate when the current level sensed by the internal current transformer exceeds the threshold value set by the adjustment knob. Provide relays with split core design for the range suitable for application. Coordinate with electrical contractor.
 7. Current Transformer: Provide current transformers rated for the specified amperage. The transformer shall provide 0 to 5 VDC output signal.
 8. Differential Pressure Switches: A diaphragm operated snap switch shall actuate the electrical circuit upon sensing of Differential Pressure. The setpoint range shall be 1 inch WC to 12 inch WC.
 9. Electrical Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc feedback signal.
 10. Air Flow Measuring Station:
 11. Fan Airflow Measuring Station with Transducer- The stations shall continuously measure the airflow through the inlet of the fan and transmit that information to the building automation system via 4-20 mA or 0-10 VDC signals. Overall accuracy of the flow measuring station shall be within 5% of actual air flow. Pressure drop shall not exceed .1" water gage.
 12. Outside Air and Ductwork Flow: Duct and Plenum Probes with Transducer- The stations shall continuously measure the airflow through the duct or louver and transmit that information to the building automation system via 4-20 mA or 0-10 VDC signals. Overall accuracy of the flow measuring station shall be within 5% of actual air flow. Pressure drop shall not exceed .1" water gage.
 13. Humidity Sensors: Bulk polymer sensor element.
 - a. Accuracy: 1 percent full range.
 - b. Room Sensors: With locking cover matching room thermostats, span of 25 to 90 percent relative humidity.

- c. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
 - 14. Pressure Transmitters: Direct acting for gas or liquid; range suitable for system; proportional output 4 to 20 mA.
 - 15. Duct Smoke Detectors: Comply with NFPA requirements. Coordinate with Division 26 and Fire Alarm Systems.
 - 16. Water Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vaporproof type. Coordinate with chiller and boiler manufacturers. Flow switches shall be approved and or provided by these manufacturers.
 - 17. Carbon-Monoxide Detectors: Single or multi-channel, dual-level detectors, using solid-state sensors with 3-year minimum life, suitable over a temperature range of 23 to 130 degrees F, calibrated for 50 to 100 ppm, with maximum 120-second response time to 100 ppm carbon monoxide.
 - 18. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23 to 130 degrees F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.
 - 19. Oxygen Sensor and Transmitter: Single detectors, using solid-state zircon cell sensing, suitable over a temperature range of minus 32 to plus 1100 degrees F, calibrated for 0 to 5 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.
 - 20. Refrigerant Detectors: Dual-level detectors, using solid-state sensors, with alarm preset for 300 ppm, alarm indicator light, alarm silence light button, alarm test light and button, and trouble light. Provide auxiliary relay preset for 150 ppm.
 - 21. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment, for flush mounting.
 - 22. Gateways and Direct LAN Connections: Coordinate with HVAC equipment manufacturers, provide and install a complete and operational control Gateway and or Direct LAN connection to the HVAC equipment. Coordinate with equipment manufacturers and other trades to avoid omission or duplication and assure a complete and operating system.
 - 23. Room Temperature Sensor: White, with concealed thermometer and override switch. Install on a sealed airtight insulated backing base.
 - 24. kW Meter: Microprocessor based power transducer with high accuracy split-core current transformers for 3-phase, 208-480 Vac, 60 Hz power measurement. Provide 4 to 20 mA, 0-10 VDC, or pulsed digital output signal. Coordinate with electrical contractor and the manufacturers of HVAC equipment.
- B. Switches and sensors applications:
- 1. Status Inputs for Fans: Current sensing relay.
 - 2. Status Inputs for Pumps: Current sensing relay.
 - 3. Status Inputs for other Electric Motors: Current-sensing relay.
 - 4. Duct Temperature Sensors: 1000 Ohm RTD Duct Sensors with operating range of 20 degrees F to 120 degrees F.
 - 5. Room Temperature Sensors: Thermistor to 55-95 degrees F with 0.5 degrees F accuracy.
 - 6. Chilled Water Pipe Temperature Sensors: 1000 Ohm RTD Liquid Immersion Sensors with operating range 20 degrees F to 70 degrees F.
 - 7. Hot Water Pipe Temperature Sensors: 1000 Ohm RTD Liquid Immersion Sensors with operating range of 30 degrees F to 250 degrees F.
 - 8. Provide and install all other components indicated for complete and operational system.

2.05 ELECTRIC THERMOSTATS

- A. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.

1. Equip thermostats, which control electric coiling fans directly, with off position on dial wired to break ungrounded conductors.

2.06 ACTUATORS

- A. Electronic Damper, Large-Valve Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 1. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
 2. Dampers: Size for running torque calculated as follows:
 3. Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
 4. Pressure Drop: Dampers with 2 to 3 Inches wg of Pressure Drop.
 5. Coupling: V-bolt and V-shaped, toothed cradle.
 6. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 7. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 10. Temperature Rating: 40 to 104 deg F.
 11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
 12. Run Time: 12 seconds open, 5 seconds closed.

2.07 CONTROL VALVES

- A. Type: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Globe Valves NPS 2 and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with back-seating capacity, repackable under pressure.
- C. Globe Valves NPS 2-1/2 and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
- D. Hydronic system globe valves shall have the following characteristics:
 1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
 2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
 3. Sizing: 3-psig maximum pressure drop at design flow rate.
 4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.
- E. Terminal Unit Control Valves: Globe valves with bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.
 1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
 2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
 3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.06 DAMPERS

- A. Dampers: AMCA-rated, opposed-blade design; 0.1084-inch minimum, galvanized-steel frames with holes for duct mounting; damper blades shall not be less than 0.0635-inch galvanized steel with maximum blade width of 8 inches. Coordinate with mechanical contractor and HVAC equipment manufacturers.
 - 1. Blades shall be secured to ½-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 degree F.
 - 3. For standard applications, include optional closed-cell neoprene edging.
 - 4. For low-leakage applications, use parallel- or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4 inches wg when damper is being held by torque of 50 in. x lbf; when tested according to AMCA 500D.
- B. Coordinate with other Division 23 Sections.

2.09 CONTROL CABLE

- A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in Division 26 Section "Control/Signal Transmission Media." Install control wiring in conduit except as specified under Part 3 of this section.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that duct, pipe, and equipment-mounted devices and wiring and piping are installed before proceeding with installation.
- C. Obtain the manufacturer data for the proposed HVAC equipment. Verify the electric power supply requirements of control interfaces and connections. Coordinate with electrical and mechanical contractors and other trades.

3.02 INSTALLATION

- A. Install DDC Controllers for a complete and operational system. Install all DDC controllers inside NEMA rated control panels.
- B. Install in accordance with manufacturer's instructions and full compliance of Division 26.
- C. Install control wiring and electrical work in accordance with National Electrical codes and Division 26. In addition to the requirements specified herein, the wiring installation shall meet the requirements of EIA/TIA Standard 568, Commercial Building Standard for telecommunication pathways and spaces.
- D. Wiring Inside Rigid Conduit: Outdoor exposed areas and areas exposed to weather. Minimum conduit size 3/4".
- E. Plenum Rated Wiring: Concealed areas above ceilings. Coordinate with electrical contractor. Support final connection wiring in accordance to National Electric Code and at every four feet. Diagonal installation shall not be accepted. Provide sleeves for wall penetrations.
- F. Identification Standards:

1. Node Identification: All nodes shall be identified by a permanent label fastened to the outside of the enclosure.
 2. Cable shall be labeled at a minimum of every 18" with the type of signal carried within the cable.
 3. Raceway Identification: All the covers to junction and pull boxes of the control raceways shall be painted with the appropriate color.
 4. Wire Identification: All low and line voltage control wiring shall be identified by a number, as referenced to the associated shop drawing and as-built drawing.
 5. Control wiring color coding shall be consistent throughout this project. Coordinate with the owner and other trades. Provide communication and control wiring with proper identification and labeling. Clearly label and color code control wiring as follows:
 - a. Orange: Local area network wiring.
 - b. Blue: Analog and digital, input or output points.
 - c. Green: Low voltage power wiring.
 - d. White: Line voltage wiring, or per National Electric Codes.
- G. Do not install low and line voltage wiring in the same conduit.
- H. Provide and install wiring and conduit in connection with HVAC instrumentation and controls for complete operational system.
- I. Provide and install electrical power supply to HVAC instrumentation and controls unless otherwise specified under Division 26. Coordinate with Division 26.
- J. Install transformers inside NEMA rated control enclosures.
- K. Label all control components and instruments.
- L. Verify the actual location of room temperature sensors prior to installation. Coordinate with furniture layout. Assure the location of each room temperature sensor is within the zone of the corresponding HVAC equipment. Verify that the room sensor locations provides an acceptable measurement of the controlled environment. Comply with ADA requirements.
- M. Perform and document comprehensive testing for all control installation. Provide necessary instruments and equipment to document the results.
 1. Verify that circuits are continuous and free from short circuits and grounds.
 2. Verify that circuits are free from unspecified ground. The resistance to ground of all circuits shall be over 50 megaOhms.
 3. Verify that circuits are free from induced voltage.
 4. Provide complete testing for all cables used under this contract. Provide all equipment, tools, and personnel as necessary to conduct these tests.
 5. Provide for complete grounding of all signal and communication cables, panels, and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
- N. Installation Quality Requirements: In addition to the requirements of Division 26, manufacturer's recommendation and National Electric Codes, provide installation quality requirements specified here for a complete and operational control system.
 1. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
 2. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
 3. Provide firestopping for all penetrations.
 4. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
 5. All wiring passing through penetrations, including walls, shall be in conduit or enclosed raceway.
 6. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

7. No penetrations in structural elements shall be made before receipt of written approval from the architect.

3.03 HVAC INSTRUMENTATION AND CONTROLS TRAINING PROGRAM

- A. Develop a comprehensive effective training program. Submit for approval.
- B. Field Training of Operators: In addition to other training requirements specified elsewhere, upon completion of work under this section and upon owner's acceptance provide 80 hours of formal classroom training for owners operators. The training shall be conducted by factory trained control engineers and technicians. This training shall be provided in 8 hour sessions at a time. A factory certified trainer shall be present during the training. Provide handouts and audio visual programs as required.
- C. Provide a professionally prepared 2-hour custom digital videotape summarizing the entire training program required for this section of this project. Production and preparation of the video tape shall be by a third party company specializing in commercial training programs. Provide electronic segmentation of the videotape with index for ease of use by the Operators. As a minimum, provide one section for each type of system and each graphic screen of the Operator's Workstation. Each segment shall be three to five minutes.

3.04 COMMISSIONING OF BUILDING AUTOMATION SYSTEM

- A. Commissioning per ASHRAE Standards. Commissioning Report shall include the following:
 1. Seventy-two (72) hour Trend Data.
 2. Installation Verification of Building Automation System.
- B. Refer to Mechanical Commissioning Section. Coordinate and provide the required expertise and services for a complete commissioning process. Coordinate with all other trades for a complete commissioned system. Coordinate with the commissioning authority.
- C. Documents results in Standard Forms recommended by DDC manufacturer or other established organizations. Comply with the similar standards established by AABC, NEBB or ASHRAE. Obtain approval prior to commencement of the work.
- D. Attend the monthly commissioning meeting. Coordinate with the commissioning authority of the project.
- E. Provide seasonal simulation to allow for a complete and operating system throughout the year. Provide a comprehensive building automation re-commissioning within 6 months of installation for seasonal adjustment.
- F. The Control Contractor's Engineer shall be present on-site for all commissioning activities involving equipment and systems controlled and monitored by the DDC system. In addition, provide no less than 45 working days for on-site support during the functional performance test.

3.05 SEVENTY-TWO (72) HOUR TREND DATA

- A. Upon completion after project provide a seventy-two (72) hour data indicating complete operation of DDC System. Final acceptance of the completion of the DDC shall be based upon the seventy-two (72) hour Trend Data. The Trend Data shall be in form of color Trend Graph. Provide Trend Data of all temperatures, air- and water- flow quantities, and equipment status points. This shall include room, outside air, chilled water, heating hot water, condensing water temperatures and set points. Trend data shall also include duct and pipe pressures and set points. The trend data shall also include variable frequency drive speed and frequency. It shall also include outside, return and supply air quantities and position of dampers. Provide trend data for kW meter and chiller operation. Submit specified list of points and graphic format of trending for approval prior to commencement of 72-hour trending. Coordinate with commissioning agent.

- B. Provide additional (72) hour trend data as required until full compliance.
- C. A factory-trained control technician with minimum of 3 years experience shall be physically present at the jobsite from 8:00 am to 5:00 pm during every 72 hour trending process until final acceptance.
- D. Upon completion submit the results indicating compliance in one complete package. Submit 6 sets.

3.06 INSTALLATION VERIFICATION OF BUILDING AUTOMATION SYSTEM

- A. CONTROLLER VERIFICATION: Perform verification procedure on each DDC controller prior to software installation and prior to commencement of point to point check-out.
- B. Verify installation of labels and nameplates to identify control components according to Division 23.
- C. Verify installation of hydronic instrument wells, valves, and other accessories according to Division 23.
- D. Document results in Standard Forms recommended by DDC manufacturer or other established organizations. Comply with similar standards established by NEBB or ASHRAE. Obtain approval prior to commencement of the work.
- E. Upon completion submit the results indicating compliance.

3.07 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
 - 3. Calibration test electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Engage a factory-authorized service representative to perform startup service.
- C. Replace damaged or malfunctioning controls and equipment.
 - 1. Start, test, and adjust control systems.
 - 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 - 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- D. Verify DDC as follows:
 - 1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
 - 2. Verify operation of operator workstation.
 - 3. Verify local control units including self-diagnostics.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. In addition to training requirements specified elsewhere, include a minimum of 32 hours' dedicated factory instructor time on-site.
3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
5. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.09 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of occupancy date based on the State Fire Marshall Permit, provide up to six Project site visits (up to 8 hours each), when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

END OF SECTION 230900

SECTION 230913 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air supply system.
- B. Thermostats.
- C. Humidistats.
- D. Control valves.
- E. Automatic dampers.
- F. Damper operators.
- G. Time clocks.
- H. Miscellaneous accessories.

1.02 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods for Testing Dampers for Rating; Air Movement and Control Association International, Inc.; 2012.
- B. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats; National Electrical Manufacturers Association; 2008.

1.03 SUBMITTALS

- A. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
- B. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- C. Manufacturer's Instructions: Provide for all manufactured components.
- D. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
- E. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Automated Logic.
- B. Other Acceptable Manufacturers:
 - 1. BAC.
 - 2. LonWorks.
 - 3. eMAC: emac.maxpg.com.

2.02 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.03 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gages, pilot lights, push buttons and switches flush on cabinet panel face.

2.04 DAMPERS

- A. Performance: Test in accordance with AMCA 500-D.
- B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage.
- C. Blades: Galvanized steel, maximum blade size 8 inches wide, 48 inches long, minimum 22 gage, attached to minimum 1/2 inch shafts with set screws.
- D. Jamb Seals: Spring stainless steel.
- E. Leakage: Less than one percent based on approach velocity of 2000 ft/min and 4 inches wg.

2.05 DAMPER OPERATORS

- A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
 - 1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 - 2. Provide one operator for maximum 36 sq ft damper section.
- B. Inlet Vane Operators:
 - 1. High pressure with pilot positioners and sufficient force to move vanes when fan is started with vanes in closed position. Return vane operator to closed position on fan shutdown.
 - 2. Product:

2.06 HUMIDISTATS

2.07 INPUT/OUTPUT SENSORS

- A. Temperature Sensors
- B. Static Pressure Sensors
- C. Equipment Operation Sensors:
 - 1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
- D. Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.
- E. Carbon Monoxide Detectors:
 - 1. Single or multichannel dual level detectors, using solid state sensors with three year minimum life. Sensor replacement shall take maximum 15 minutes. Suitable over temperature range of 23 to 130 degrees F.

2.06 THERMOSTATS

- A. Electric Room Thermostats:
 - 1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
 - 2. Service: cooling and heating.
 - 3. Covers: Locking with set point adjustment, with thermometer.
- B. Room Thermostat Accessories:
 - 1. Insulating Bases: For thermostats located on exterior walls.
 - 2. Aspirating Boxes: Where indicated for thermostats requiring flush installation.
- C. Airstream Thermostats:
 - 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.

2.09 TIME CLOCKS

- A. Seven day programming switch timer with synchronous timing motor and seven day dial, continuously charged Ni-cad battery driven power failure 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals per day with two normally open and two normally closed output switches.

2.10 TRANSMITTERS

- A. Building Static Pressure Transmitter:
 - 1. One pipe, direct acting, double bell, scale range 0.01 to 6.0 inch wg positive or negative, and sensitivity of 0.0005 inch wg. Transmit electronic signal to receiver with matching scale range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that systems are ready to receive work.
- B. Beginning of installation means installer accepts existing conditions.
- C. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- D. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- E. Ensure installation of components is complementary to installation of similar components.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of thermostats with plans and room details before installation. Locate 60 inches above floor. Align with lighting switches. Refer to Section 26 27 26.
- C. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors. Provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
- D. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment

room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

- E. Provide conduit and electrical wiring in accordance with Section 26 27 17. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

END OF SECTION 230913

SECTION 230943 - PNEUMATIC CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Signal selectors.
- B. Multi-purpose positioning relays.
- C. Transmitters.
- D. Receiver controllers.
- E. Control panels.
- F. Alarm systems.
- G. Miscellaneous accessories.

1.02 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SYSTEM DESCRIPTION

- A. Provide pneumatic control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested.
- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- D. Certificates: Certify that Products meet or exceed specified requirements.
- E. Manufacturer's Instructions: Include for all manufactured components.
- F. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Revise shop drawings to reflect actual installation and operating sequences.
- G. Operation and Maintenance Data: Include systems descriptions, set points, and controls settings and adjustments. Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed at Project Location.

- C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Johnson Controls, Inc: www.johnsoncontrols.com.

2.02 WATER TEMPERATURE CONTROLLERS

- A. Operate on adjustable differential over adjustable temperature range and suitable for operating control valve provided.

2.03 RECEIVER CONTROLLERS

- A. Single or dual input models with control point adjustment direct or reverse acting with mechanical set point adjustment with locking device, proportional band adjustment, and authority adjustment. Provide proportional control mode.
- B. Remote control point adjustment shall be plus or minus 20 percent of sensor span, input signal 3 to 13 psig.
- C. Proportional band shall extend from 2-1/2 to 40 percent of primary sensor span, authority from 10 to 200 percent of primary sensor span and integral time 0.5 to 20 min.
- D. Suitable for supply air pressure of 18 psig with input signals of 3 to 15 psig and output signal 0 to 15 psig.

2.04 PNEUMATIC SYSTEMS ACCESSORIES

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide conduit and electrical wiring where required. Refer to Section 26 27 17.
- B. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.
- C. Test pneumatic systems to system pressure maximum of 30 psig. Check calibration of instruments. Recalibrate or replace.

END OF SECTION 230943

SECTION 232300 - REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Filter-driers.
- F. Expansion valves.

1.02 REFERENCE STANDARDS

- A. AHRI 710 - Performance Rating of Liquid-Line Driers; Air-Conditioning, Heating, and Refrigeration Institute; 2009.
- B. AHRI 750 - Standard for Thermostatic Refrigerant Expansion Valves; Air-Conditioning, Heating, and Refrigeration Institute; 2007.
- C. AHRI 760 - Standard for Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; Air-Conditioning, Heating, and Refrigeration Institute; 2007.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010 (ANSI/ASHRAE Std 15).
- E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010.
- F. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2010).
- G. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes; The American Society of Mechanical Engineers; 2011.
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.
- I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2005 (Reapproved 2011).
- J. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2008.
- K. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2011 and errata.
- L. UL 429 - Electrically Operated Valves; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
- D. Valves:
 - 1. Use service valves on suction and discharge of compressors.
 - 2. Use gage taps at compressor inlet and outlet.
- E. Filter-Driers:
 - 1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
- F. Solenoid Valves:
 - 1. Use in liquid line of single or multiple evaporator systems.

1.04 SUBMITTALS

- A. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.
- B. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
 - 1. Fittings: ASME B16.26 cast copper.
 - 2. Joints: Flared.
- C. Pipe Supports and Anchors:
 - 1. Conform to ASME B31.5.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.

2.02 REFRIGERANT

- A. Refrigerant: R-410A as defined in ASHRAE Std 34.

2.03 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.04 VALVES

- A. Service Valves:
 - 1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.05 FILTER-DRIERS

- A. Performance:
 - 1. Flow Capacity - Liquid Line: per manufactures recommendation, minimum, rated in accordance with AHRI 710.
 - 2. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
 - 3. Design Working Pressure: per manufactures recommendation, minimum.
- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- C. Construction: UL listed.
 - 1. Connections: As specified for applicable pipe type.

2.06 SOLENOID VALVES

- A. Valve: AHRI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi.
- B. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access to concealed valves and fittings.

- H. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

3.03 SCHEDULES - SEE SHEET M-3.2

END OF SECTION 232300

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.
- B. Nonmetal ductwork.
- C. Casing and plenums.
- D. Duct cleaning.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.
- C. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2012.
- D. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.
- E. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.
- F. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association; 2003.
- G. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03 PERFORMANCE REQUIREMENTS

- A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.04 SUBMITTALS

- A. Product Data: Provide data for duct materials, duct liner, and duct connections.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A standards.

1.06 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

2.02 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Flexible Ducts:
 - 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
 - a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 - b. Maximum Velocity: 4000 fpm.
 - c. Temperature Range: -20 degrees F to 210 degrees F.
- C. Insulated Flexible Ducts:
 - 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
 - a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 - b. Maximum Velocity: 4000 fpm.
 - c. Temperature Range: -20 degrees F to 210 degrees F.
- D. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
- E. Hanger Rod: ASTM A 36/A 36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.03 DUCTWORK FABRICATION

- A. Fabricate ductwork gauge in accordance with current (CMC) California Mechanical Code and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. T's, bends, and elbows: Construct according to (CMC) California Mechanical Code and SMACNA (DCS).
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards.
- F. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- G. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 DUCT MANUFACTURERS

- A. Metal-Fab, Inc: www.mtlfab.com.
- B. SEMCO Incorporated: www.semcoinc.com.
- C. United McGill Corporation: www.unitedmcgill.com.

2.05 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Grease Exhaust: Nominal 3 inches thick ceramic fiber insulation between 20 gage, 304 stainless steel liner and 24 gage, aluminized steel outer jacket.
 - 1. Tested and UL listed for use with commercial cooking equipment in accordance with NFPA 96.
 - 2. Certified for zero clearance to combustible material in accordance with:
 - 3. Materials and construction of the modular sections and accessories to be in accordance with the terms of the following listings:
 - 4. Manufacturers:

2.06 CASINGS

- A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards and construct for operating pressures indicated.
- B. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- C. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- D. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
- E. Fabricate acoustic casings with reinforcing turned inward. Provide 16 gage back facing and 22 gage perforated front facing with 3/32 inch diameter holes on 5/32 inch centers. Construct panels 3 inches thick packed with 4.5 lb/cu ft minimum glass fiber media, on inverted channels of 16 gage.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.
- B. Install in accordance with manufacturer's instructions.
- C. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- D. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

- G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- H. Use double nuts and lock washers on threaded rod supports.
- I. Connect terminal units to supply ducts with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- J. Connect diffusers or light troffer boots to low pressure ducts with 7 feet maximum length of flexible duct held in place with strap or clamp.
- K. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- L. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

3.02 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.03 SCHEDULES

- A. Ductwork Material:
 - 1. Low Pressure Supply (Heating Systems): Steel, Aluminum, Fibrous Glass.
 - 2. Low Pressure Supply (System with Cooling Coils): Steel, Aluminum, Fibrous Glass.
 - 3. Return and Relief: Steel, Aluminum.
 - 4. General Exhaust: Steel, Aluminum.
 - 5. Kitchen Hood Exhaust: Steel, Stainless Steel.
 - 6. Outside Air Intake: Steel.
 - 7. Combustion Air: Steel.
 - 8. Evaporative Condenser Intake and Exhaust: Steel.
 - 9. Emergency Generation Ventilation: Steel.
- B. Ductwork Pressure Class:
 - 1. Supply (Heating Systems): 1/2 inch
 - 2. Supply (System with Cooling Coils): 1/2 inch.
 - 3. Return and Relief: 1/2 inch.
 - 4. Outside Air Intake: 1/2 inch.
 - 5. Combustion Air: 1/2 inch.
 - 6. Emergency Generation Ventilation: 1/2 inch

END OF SECTION 233100

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Backdraft dampers.
- D. Combination fire and smoke dampers.
- E. Duct access doors.
- F. Duct test holes.
- G. Fire dampers.
- H. Flexible duct connections.
- I. Smoke dampers.
- J. Volume control dampers.

1.02 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.
- B. NFPA 92 - Standard for Smoke-Control Systems; 2012.
- C. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.
- D. UL 33 - Heat Responsive Links for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- E. UL 555 - Standard for Fire Dampers; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- F. UL 555S - Standard for Leakage Rated Dampers for Use in Smoke Control Systems; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, and hardware used. Include electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

1.04 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
 - 1. Krueger: www.krueger-hvac.com.
 - 2. PCI Industries, Inc; Pottorff Brand: www.portorff.com.
 - 3. Ruskin Company: www.ruskin.com.
 - 4. Titus: www.titus-hvac.com.
- B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with worm drive mechanism with removable key operator.

2.02 BACKDRAFT DAMPERS - METAL

2.03 BACKDRAFT DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc: www.louvers-dampers.com.
 - 2. Nailor Industries Inc: www.nailor.com.
 - 3. PCI Industries, Inc; Pottorff Brand: www.portorff.com.
 - 4. Ruskin Company: www.ruskin.com.
- B. Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

2.04 BACKDRAFT DAMPERS - FABRIC

- A. Fabric Backdraft Dampers: Factory-fabricated, 18 gage, galvanized steel frame.
 - 1. Blades: Neoprene coated fabric material.
 - 2. Birdscreen: 1/2 inch nominal mesh of galvanized steel or aluminum.
 - 3. Maximum Velocity: 1000 fpm (5 m/sec) face velocity.

2.05 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 - 1. PCI Industries, Inc; Pottorff Brand: www.portorff.com.
 - 2. Ruskin Company: www.ruskin.com.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Provide factory sleeve and collar for each damper.
- D. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on interior of duct and link to damper operating shaft.

2.06 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Nailor Industries Inc: www.nailor.com.
 - 2. Ruskin Company: www.ruskin.com.
 - 3. SEMCO Incorporated: www.semcoinc.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

2.07 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.08 FIRE DAMPERS

- A. Manufacturers:
 - 1. PCI Industries, Inc; Pottorff Brand: www.pottorff.com.
 - 2. Ruskin Company: www.ruskin.com.
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Ceiling Dampers: Galvanized steel, 22 gage frame and 16 gage flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
- D. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- E. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.09 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.

2.10 SMOKE DAMPERS

- A. Manufacturers:
 - 1. PCI Industries, Inc; Pottorff Brand: www.pottorff.com.
 - 2. Ruskin Company: www.ruskin.com.
- B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.

2.11 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc: www.louvers-dampers.com.
 - 2. Nailor Industries Inc: www.nailor.com.
 - 3. PCI Industries, Inc; Pottorff Brand: www.pottorff.com.
 - 4. Ruskin Company: www.ruskin.com.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
- D. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment; see Section 22 05 48.
- J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 233300

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.
- C. Door grilles.
- D. Louvers.
- E. Goosenecks.

1.02 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 2012.
- B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute; 2008.
- C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.; 2006.
- D. SMACNA (DCS) - HVAC Duct Construction Standards; 2005.

1.03 SUBMITTALS

- A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.04 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Krueger: www.krueger-hvac.com.
- B. Titus: www.titus-hvac.com.

2.02 RECTANGULAR CEILING DIFFUSERS

- A. Type: Square, stamped, multi-core diffuser to discharge air in 360 degree pattern with sectorizing baffles where indicated.
- B. Frame: Surface mount type. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabrication: Aluminum with baked enamel off-white finish.

2.03 CEILING SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.
- B. Frame: 1 inch margin with countersunk screw mounting and gasket.
- C. Fabrication: Aluminum extrusions with factory off-white enamel finish.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.04 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.
- B. Frame: 1 inch margin with countersunk screw mounting.
- C. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.05 DOOR GRILLES

- A. Type: V-shaped louvers of 20 gage thick steel, 1 inch deep on 1/2 inch centers.
- B. Frame: 20 gage steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

2.06 LOUVERS

- A. Type: 4 inch deep with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh screen over exhaust and 1/2 inch square mesh screen over intake.
- B. Fabrication: 12 gage thick extruded aluminum, welded assembly, with factory prime coat finish color to be selected.
- C. Mounting: Furnish with interior flat flange for installation.

2.07 GOOSENECKS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards of minimum 18 gage galvanized steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

3.02 SCHEDULES SHOWN ON SHEET M-0.1

END OF SECTION 233700

SECTION 237413 - PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged roof top unit.
- B. Unit controls.
- C. Roof mounting curb and base.
- D. Maintenance service.

1.02 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilation Systems; National Fire Protection Association; 2012.

1.03 SUBMITTALS

- A. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- B. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- D. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.05 WARRANTY

- A. Provide a five year warranty to include coverage for refrigeration compressors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carrier Corporation: www.carrier.com
- B. Trane Inc: www.trane.com.
- C. York International Corporation/Johnson Controls: www.york.com.

2.02 AIR CONDITIONING UNITS

- A. General: Roof mounted units having gas burner and electric refrigeration.
- B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, heat exchanger and burner, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.
- C. Disconnect Switch: Factory mount disconnect switch in control panel.

2.03 FABRICATION

- A. Cabinet: Steel with baked enamel finish, including access panels with screwdriver operated flush cam type fasteners. Structural members shall be minimum 18 gage, with access doors or panels of minimum 20 gage.
- B. Heat Exchangers: Aluminized steel, of welded construction.
- C. Supply Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch motor pulley, and rubber isolated hinge mounted high efficiency motor. Isolate complete fan assembly. Refer to Section 23 05 48.
- D. Air Filters: media with extended surface media filters. Refer to Section 23 40 00.
- E. Roof Mounting Curb: 24 inches high galvanized steel, channel frame with gaskets, nailer strips.

2.04 BURNER

- A. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot.
- B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.
- C. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- D. Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, with provisions for continuous fan operation.

2.05 EVAPORATOR COIL

- A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
- B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

2.06 COMPRESSOR

- A. Provide semi-hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gage ports, and filter drier.

2.07 CONDENSER COIL

- A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.

- B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Provide high efficiency fan motors.
- C. Provide refrigerant pressure switches to cycle condenser fans.

2.08 MIXED AIR CASING

- A. Dampers: Provide remote controlled outside and return air dampers with damper operator and remote CO2 sensor for adjusting outside air quantity.
- B. Gaskets: Provide tight fitting dampers with edge gaskets.
- C. Damper Operator: Pneumatic piston or gear driven type with spring return and pilot positioner.
- D. Mixed Air Controls: Maintain selected supply air temperature and return dampers to minimum position on call for heating and above 75 degrees F ambient, or when ambient air temperature exceeds return air temperature.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 90A.
- C. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

3.03 SYSTEM STARTUP

- A. Prepare and start equipment. Adjust for proper operation.

3.04 CLOSEOUT ACTIVITIES

- A. Demonstrate operation to Owner's maintenance personnel.

3.05 MAINTENANCE

- A. Provide service and maintenance of packaged roof top units for one year year from Date of Substantial Completion.
- B. Provide routine maintenance service with a two month interval as maximum time period between calls.
- C. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.
- D. After each service call, submit copy of service call work order or report that includes description of work performed.

3.06 SCHEDULES - SEE SHEET M-0.1

END OF SECTION 237413

SECTION 238127 - SMALL SPLIT-SYSTEM HEATING AND COOLING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Forced air furnaces.
- B. Air cooled condensing units.
- C. Indoor ductless fan & coil units.
- D. Controls.

1.02 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; Air-Conditioning, Heating, and Refrigeration Institute; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010 (ANSI/ASHRAE Std 15).
- D. ASHRAE Std 23.1 - Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010.
- E. ASHRAE Std 90.2 - Energy-Efficient Design of New Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2007.
- F. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2012.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2012.

1.03 SUBMITTALS

- A. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- B. Design Data: Indicate refrigerant pipe sizing.
- C. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- E. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.04 WARRANTY

- A. Provide five year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carrier Corporation: www.carrier.com.
- B. Trane Inc: www.trane.com.

- C. York International Corporation / Johnson Controls: www.york.com.

2.02 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
1. Heating: Natural gas fired.
 2. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
 3. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- B. Performance Requirements: See Drawings for additional requirements.
- C. Electrical Characteristics:
1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 26 27 17.

2.03 INDOOR UNITS FOR DUCTLESS SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
- B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
1. Construction and Ratings: In accordance with AHRI 210/240 and UL listed.
 2. Manufacturer: System manufacturer.

2.04 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
1. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL listed.
- B. Compressor: ARI 520; hermetic, two speed 1800 and 3600 rpm, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: ARI 520; Aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
- D. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gage ports, thermometer well (in liquid line).
- E. Operating Controls per detail #3 on sheet M-3.4 for split systems
1. Ductless Split System Control by room thermostat to maintain room temperature setting.
 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

2.05 GAS FURNACE COMPONENTS

- A. Heat Exchanger: Aluminized and stainless steel tubular type.
- B. Burner: Atmospheric type with adjustable combustion air supply,

1. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
 2. Electronic pilot ignition, with electric spark igniter.
 3. Combustion air damper with synchronous spring return damper motor.
 4. Non-corrosive combustion air blower with permanently lubricated motor.
- C. Burner Safety Controls:
1. Thermocouple Sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
 2. Flame Rollout Switch: Installed on burner box and prevents operation.
 3. Vent Safety Shutoff Sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
 4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.
- D. Operating Controls per detail #3 on sheet M-3.4
- E. Flue Termination: Standard roof kit.

2.06 ACCESSORY EQUIPMENT

- A. Economizer Damper Units: Steel cabinet with baked enamel finish, easily removed and secured access doors, glass fiber insulation.
1. Dampers: Formed steel with nylon bearings and gaskets.
 2. Damper Operator: 24 volt, three position spring return motor with adjustable minimum position switch.
 3. Control Wiring: Provide wiring harness consisting of control board with relays, wiring harness, transformer, and hardware.
 4. Controls: per detail #3 on sheet M-3.4
- B. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with CO2 sensor to maintain temperature setting; low-voltage; with following features:
1. Automatic switching from heating to cooling.
 2. Preferential rate control to minimize overshoot and deviation from setpoint.
 3. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 4. Short cycle protection.
 5. Programming based on every day of the week.
 6. Selection features including degree F or degree C display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.
 7. Battery replacement without program loss.
 8. Thermostat display:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. System mode indication: heating, cooling, fan auto, off, and on, auto or on, off.
 9. Manufacturers:
 - a. Carrier Corporation: www.carrier.com.
 - b. Trane Inc: www.trane.com.
 - c. York International Corporation / Johnson Controls: www.york.com.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.
- C. Verify that proper fuel supply is available for connection.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Install gas fired furnaces in accordance with NFPA 54.
- D. Provide vent connections in accordance with NFPA 211.
- E. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION 238127

SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE

- A. This section supplements all sections of this division and shall apply to all phases of work hereinafter specified, shown on the drawings, or required to provide a complete installation of electrical systems for the Project. The work required under this division is not limited to the electrical specifications and drawings. Refer to all bid documents including Civil, Architectural, Structural, and Mechanical documents which may designate Work to be accomplished. The intent of the Specifications is to provide a complete and operable electrical system, which shall include all documents that are a part of the entire Project Contract.
 - 1. Work included: Furnish all labor, material, tools, equipment, facilities, transportation, skilled supervision necessary for, and incidental to, performing operations in connection with furnishing, delivery, and installation of the work in this division complete as shown or noted on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Refer to all sections in the general contract conditions, Contract Requirements and Division 1, General Requirements.
- C. Work Installed but Furnished by Others:
 - 1. The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify installation details. Foundations for apparatus and equipment will be furnished by others unless otherwise noted or detailed.

1.02 GENERAL REQUIREMENTS

- A. Guarantee See General Conditions:
 - 1. Except as may be specified under other Sections in the specification, guarantee equipment furnished under the specifications for a period of one year, except for equipment required to have a longer guarantee period, from date of final completion. Guarantee all work against defective workmanship, material, and improper installation. Upon notification of failure, correct deficiency immediately and without additional cost to the Owner.
 - 2. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner or his service agency as approved. Furnish to the Owner, through the Architect, printed manufacturer's warranties complete with material included and expiration dates, upon completion of project. Conform to Division 01.
- B. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed and certified by a nationally recognized testing authority where UL does not have an approval. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.
- C. Codes and Regulations:
 - 1. Design, manufacturer, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:
 - a. Institute of Electrical and Electronic Engineers - IEEE
 - b. National Electrical Manufacturers' Association - NEMA
 - c. Underwriters' Laboratories, Inc. - UL
 - d. National Fire Protection Association - NFPA
 - e. American Society for Testing and Materials - ASTM

- f. American National Standards Institute - ANSI
 - g. California Electrical Code - CEC, Title 24, Part 3
 - h. California Code of Regulations, Title 8, Subchapter 5
 - i. California Building Code-CBC, Title 24 Parts 1 & 2
 - j. State & Municipal Codes in Force in the Specific Project Area
 - k. Occupational Safety & Health Administration - OSHA
 - l. California State Fire Marshal
 - m. California Fire Code- CFC, Title 24 Part 9
 - n. National Electrical Testing Association - NETA
2. The term "Code", when used within the specifications, shall refer to the Publications, Standards, ordinances and codes, listed above. In the case where the codes have different levels of requirements the most stringent rules shall apply.
- D. Requirements of Regulatory Agencies:
- 1. Codes, Permits, and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply. The most stringent condition shall be as interpreted by the Engineer.
 - a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Contractor at his expense shall obtain the Work, unless otherwise specified.
 - b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.
- E. Shop Drawings:
- 1. See Division 01 for additional requirements.
 - 2. Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery of materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.
 - 3. Submittals will be checked for general compliance with specifications only. The Contractor shall be responsible for deviations from the drawings or specifications and for errors or omissions of any sort in submittals.
 - 4. Submit a complete list of materials and equipment proposed for the job, including manufacturers names and catalog numbers.
 - 5. Shop drawings shall be submitted in completed groups of materials (i.e., lighting fixtures or switchgear). The Contractor shall add and sign the following paragraph on equipment and materials submitted for review. "It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into the project; is in compliance with the Contract Drawings and specifications and can be installed in the allocated spaces". Failure to add the above written statement for compliance will result in return of submittals without review.
 - a. Bind catalog cuts, plate numbers, descriptive bulletins and drawings, 11" x 17" (275 mm x 435 mm) or smaller, in sets with covers neatly showing titles.
 - b. The Contractor shall verify dimensions of equipment and be satisfied as to Code compliance for fit prior to submitting shop drawings for approval.
 - c. Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals shall not be reviewed unless supporting calculations and data are submitted therewith.
 - d. Include complete catalog information such as construction, ratings, insulation systems, as applicable.
 - e. For any material specified to meet UL or trade standards, furnish the manufacturers or vendor's certification that the material furnished for the work does in fact equal or exceed such specifications.

- f. Reference listings to the specifications' Sections and Article to which each is applicable.
 - g. Equipment Floor Plans: After approval of material is secured prepare a floor plan of each electrical and communication equipment space, room or yard, drawn to scale at 1/2 inch equals 1 foot and submit for approval in the same manner as for shop drawings. The layout drawings shall be exact scale.
6. Contractor shall prepare coordinated drawings when required by Division 01 or where noted otherwise.
- F. Interpretations: The Contractor through the Architect must make Requests for interpretations of drawings and specifications. Any such requests made by equipment manufacturers or suppliers will be referred to the Contractor.
- G. Standard of Quality
- 1. The contract Drawings and Specifications establish the "MINIMUM STANDARD OF QUALITY" each product and/or system must meet to be considered acceptable. Products of other manufactures will be considered if the product and/or system meet or exceed the "MINIMUM STANDARD OF QUALITY" established by this Contract Document.
 - 2. Items for similar application shall be of the same manufacturer.
 - 3. The label of listing by UL shall appear on all materials and equipment for which standards have been established by the agency.
 - 4. Where codes as listed in Section General Requirement Section of the Specifications that establish label or approved requirements, furnish all materials and equipment with either the required labels affixed or the necessary written approval.
 - 5. Provide the type and quantity of electrical materials and equipment necessary to complete Work and all systems in operation, tested and ready for use.
 - 6. Provide and install all incidental items that belong to the Work described and which are required for complete systems.
 - 7. All switchboards, distribution boards, panel boards and circuit breakers shall be of the same manufacturer.
 - 8. All wiring devices such as switches and receptacles shall be of the same manufacturer.
- H. Substitutions: Refer to Division 01
- I. Submit comprehensive material list, shop drawings and complete technical data for the following equipment and materials:
- 1. General Requirements:
 - a. Main service and distribution switchboards.
 - b. Panelboards.
 - c. Conduits
 - d. Conductors, include all selected insulation types.
 - e. Fuses
 - f. Disconnect switches and Starters.
 - g. Pullboxes, manholes and handholes.
 - h. Standard lighting fixtures, specially fabricated fixtures, ballasts and lamps, with samples and sample of standard finish available (where requested).
 - i. Control devices, standard and special receptacles, switches, outlets and finish device plates.
 - j. Cabinets for signal and telephone system, special terminals and cabinets. Include all cabinet dimensions.
 - k. Fire alarm system.
 - l. Transformers
- J. Utility Service:
- 1. Contractor shall verify the locations shown on the drawings and shall include extensions of lines to building service from locations which are acceptable to the Owner.
 - 2. Verify electrical, civil, architectural and structural, dimensional and other requirements with the Owner.

3. Should any major modifications to the work indicated be necessary to comply with the Owner requirements, notify the Architect.
 4. Contractor shall contact the utility company representatives to establish pre-construction coordination, obtain all necessary meters and/or approvals, and schedule utility work to coordinate with the construction schedule.
 5. All utility services shall be installed per the utility company requirements. Verify final construction requirements with utility company service planners prior to construction.
- K. Record Drawings: Refer to Division 01, Contract Closeout.
- L. Work Responsibilities:
1. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, junction boxes and equipment and are to be followed. Execute the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations. The Contractor is responsible for the correct placing of his work. Where conflicts occur in plans and/or specifications, the most stringent application shall apply and shall be part of the base bid.
 2. Locations shown on architectural plan or on wall elevations shall take precedence over electrical plan locations, but where a major conflict is evident, notify the Architect.
 3. In the event minor changes in the indicated locations or arrangement are necessary due to developed conditions in the building construction or rearrangement of furnishings or equipment or due to interference with other trades, such changes shall be made without extra cost.
 4. Verify dimensions and the correct location of Owner-Furnished equipment before proceeding with the roughing-in of connections.
 5. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with work carefully check and verify dimensions and sizes with the drawings to see that the furnished equipment will fit into the spaces provided without violation of applicable Codes.
 6. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Architect.
 7. Contractor shall be responsible for coordination of coordinated drawings when required by the Architect.
 8. Replace or repair, without additional compensation any work which does not comply with or which is installed in violation of any of these requirements.
- M. Installation General: For special requirements, refer to specific equipment under these requirements.
1. Unless otherwise specified elsewhere in the specifications, do all excavating necessary for the proper installation of the electrical work.
 2. Locations of Openings: Locate chases, shafts and openings required for the installation of the electrical work during framing of the structure. Do any additional cutting and patching required. Cutting or drilling in any structural member is prohibited without approval of the Architect. Furnish all access panels to make all boxes, connections and devices accessible as required by CEC.
 3. Location of Sleeves: Where conduits pass through concrete walls, suspended slabs or metal deck floors, install sleeves of adequate size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify locations.
 4. Wherever conduit extends through roof, install flashings in accordance with drawings and details.
 5. Contractor shall be responsible for cutting and patching which may be required for the proper installation of the electrical work.
 6. Protect work, materials and equipment and provide adequate and proper storage facilities during the progress of the work. Storage outdoors shall be weather protected and shall include space heaters to prevent condensation. Provide for the safety and good condition

of all work until final acceptance of the work. Replace all damaged or defective work, materials and equipment before requesting final acceptance.

7. Conduit and Equipment to be Installed: Clean thoroughly to remove plaster, spattered paint, cement and dirt on both exterior and interior. All underground conduits shall be mandrelled prior to pulling wire.
 8. Conduit and Equipment to be Painted: Clean conduit exposed to view in completed structure by removing plaster and dirt. Remove grease, oil and similar material from conduit and equipment by wiping with clean rags and suitable solvents in preparation for paint.
 9. Items with Factory Finish: Remove cement, plaster, grease and oil, and leave surfaces, including cracks and corners, clean and polished. Touch up scratched or bare spots to match finish.
 10. Site Cleaning: Remove from site all packing cartons, scrap materials and other rubbish on a weekly basis. Vacuum out all cabinets, switchgear and panels and junction boxes prior to pulling any conductors.
 11. Electrical equipment and materials exposed to public and in finished areas shall be finish-painted after installation in accordance with the Painting Section. All exposed screw-type fasteners, exterior, or interior in restrooms, shall be vandal-resistant spanner type; include tool.
- N. Excavation, Cutting and Patching:
1. Excavating, trenching and backfilling required for the work of this Division in accordance with the applicable requirements of Division 2. Excavating and backfilling connected with electrical work, repaving cuts and providing and maintaining protective measures for the electrical work excavation required by the governing authorities having jurisdiction shall be performed as a part of the work of this Division.
 2. Verify openings indicated on the drawings. Provide all cutting, patching and reinforcement of the construction of the building as required to install electrical work.
- O. Tests
1. Equipment and systems for which the National Electrical Testing Association (NETA) has an approved or recommended procedure, shall be tested in accordance with that procedure. Test values shall equal values recommended by NETA. Copies of test reports shall be submitted as required under shop drawing submittals.
 2. Resistance to ground tests shall be accomplished by a qualified independent testing firm to measure resistance to ground at grounding electrodes. Make tests before slabs or affected areas are poured in order that corrective measures, if required, may be taken. Submit a report showing the results of these measurements. If the resistances exceed values specified elsewhere or NETA test procedure recommendations, perform corrective measures required to reduce resistance to acceptable values.
 3. Prior to energizing any motor, measure the service voltage for phase balance and report if unbalance exceeds 1% from mean.
 4. Measure the three-phase voltage at no load and at maximum load conditions and submit to the engineer a report showing the results of these measurements.
 5. Upon completion of the work and adjustment of all equipment, conduct an operating test. Conduct the test in the presence of an authorized representative of the Owner's Representative. Demonstrate system and equipment to operate in accordance with requirements of the Contract Documents and to be free from electrical and mechanical defects. Provide systems free from short circuits and grounds and show an insulation resistance between phase conductors and ground not less than the requirements of the governing electric code. Test circuits for proper neutral connection.
 6. Complete tests prior to final inspection of project, including corrective work based on the results of the tests.
 7. Perform special tests on systems and equipment as specified herein using personnel qualified to perform such tests.

- P. Protection: Protect finish parts of the materials and equipment against damage during the progress of the work and until final completion and acceptance. Cover materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred. Keep moving parts clean, dry and lubricated.
- Q. Cleaning Up:
1. Upon completion of the work and at various time during the progress of the work, remove from the building all surplus materials, rubbish and debris resulting from the work of this Division.
 2. Thoroughly clean switchgear including busses, apparatus, exposed conduit, metal work including the exterior and interior, and accessories for the work of this Division, of cement, plaster and other deleterious materials; remove grease and oil spots with cleaning solvent; carefully wipe surfaces and scrape cracks and corners clean.
 3. Thoroughly polish chromium or plated work. Remove dirt and stains from lighting fixtures.
 4. Leave the entire installation in a clean condition.
- R. Completion:
1. The work will not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, panel directories and nameplates specified herein have been approved and properly posted or installed and final cleaning of equipment and premises has been completed.
 2. When the installation is complete and adjustments have been made, operate the system for a period of one week, during which time demonstrate that systems are completed and operating in conformance with the specifications.
- S. Operating and Maintenance Data: Submit complete and at one time, prior to acceptance of the installation, 4 copies of manufacturer's instructions for operation and maintenance of electrical equipment, including replacement parts lists. As specified in Division 01
- T. Inspection and Acceptance Procedures: The Architect will submit observation reports periodically during the construction phase detailing Contract deficiencies. The Contractor is responsible for making corrections immediately. Notice of Completion of the project will not be made until all items have been corrected.
- U. Final Completion of Electrical Systems:
1. Prior to Final Completion of operating electrical systems, the Contractor shall:
 - a. Provide materials of the type and quality specified and as necessary for proper operation, tested and ready for use.
 - b. Furnish the required Operating and Maintenance Data/Manuals.
 - c. Clean up of the project pertaining to this Division of the work.
 - d. After installation has been completed and adjustments made, operate the system for a period of one week, during which time, demonstrate to the Architect that systems are complete and operating in conformance with Contract Documents.
 - e. Conduct tests required and as specified in this Division and submit test reports and corrective actions taken.
 - f. Submission of warranties and guarantees.
 2. Final Completion of Work Shall be Contingent On:
 - a. Contractor replacing defective materials and workmanship.
 - b. Upon completion of work and adjustments made, Contractor shall conduct an operating test for each system for approval at such time as Architect directs. Conduct test in presence of authorized representative of Architect and demonstrate that systems and equipment do operate in accordance with requirements of the Contract Documents and are free from electrical and mechanical defects.
 - c. Contractor shall provide the necessary training programs and instructions to the Owner's representative. Number of hours shall be a minimum of four (4) hours for each system or days as required under separate Sections of these Specifications. Complete operation and maintenance manuals shall be provided at least two (2) weeks prior to training.

- d. Submit copies of manufacturer's instructions and maintenance of electrical equipment including replacement parts lists. Each set shall include one set of shop drawings of equipment installed.
- V. Submittals for Change Orders: When changes are made during the construction phase, deletions and additions shall be presented in a manner that will indicate the cost of each item of material and corresponding labor. Markup shall be then added in accordance with the requirements of the General Conditions as modified by the Supplementary Conditions.
- W. The Contractor at a time convenient to the Owner shall provide instruction to the Owner's operating personnel in the proper operation and maintenance of all equipment and systems. The instructors shall have received factory training and shall be thoroughly familiar with the equipment installed. The operating personnel shall receive the number of days instruction as indicated in other sections.

1.03 PROJECT RECORD DOCUMENTS

- A. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- B. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- C. Final Record Drawings: Conform to Division 01 requirements.
- D. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- E. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- F. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.
- G. At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies, a complete separate, clean, undamaged set of the latest stamped, actioned submittals. As work progresses, maintain records of "as installed" conditions on this set in suitable ink or chemical fluid. Update the set daily. After successful completion of Project Site testing specified herein, and after completion of Punch List corrections, copy all records of "as installed" conditions on to originals.
- H. Quantity:
 - 1. Review sets: As for Shop and Field Drawings.
 - 2. Record set: Refer to Division 01.
- I. Format: Record Drawings:
 - 1. Pencil, permanent ink or permanent photographic process.
 - a. Front face only of Mylar at least 3.0 mils thick.
 - b. Appliqué film or lettering prohibited.
 - c. Suitable for microfilming. Lettering 1/8" (.8 mm) high minimum.
- J. Content: All drawings required under "Field and Shop Drawings". Show "as installed" condition. Where room designations according to Project permanent signage differ from construction designations in the Contract Documents, show both designations.
- K. Warranty Certificates: Comply with Division 01.

PART 2 - PRODUCT

2.01 NOT USED

PART 3 - INSTALLATION

3.01 NOT USED

END OF SECTION 260010

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wire and cable for 600 volts and less.
- C. Wiring connectors.
- D. Electrical tape.
- E. Heat shrink tubing.
- F. Wire pulling lubricant.

1.02 REFERENCE STANDARDS

- A. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- B. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2008.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- D. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- G. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- H. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- I. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.03 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 Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.04 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, construction, ratings, listings, and available sizes, configurations, and stranding.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

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. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.

2.02 CONDUCTOR AND CABLE MANUFACTURERS

- A. Anaconda Power Cables
- B. Carol Cable
- C. Rome Wire and Cable
- D. Pirelli Wire and Cable
- E. Okonite Wire
- F. Canada Wire
- G. Cerro Wire LLC: www.cerrowire.com.
- H. Encore Wire Corporation: www.encorewire.com.
- I. Southwire Company: www.southwire.com.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
- C. Insulation Voltage Rating: 600 V.

- D. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.
 - 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.
- E. Type THWN for exterior or wet locations, in raceway.

2.04 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. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors or compression connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use split bolt mechanical connectors.
- C. 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.
 - 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 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.
- D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- F. 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.
- G. Mechanical Connectors: Provide bolted type.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.
- I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.05 WIRING ACCESSORIES

- A. Electrical Tape:
 - 1. 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.

2. 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.
 3. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 4. 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.
 5. 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.
 - C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

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 shown on the drawings.
- 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.

3.03 INSTALLATION

- A. Circuiting Requirements:
 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 2. When circuit destination is indicated and routing is not shown, determine exact routing required.
 3. Arrange circuiting to minimize splices.
 4. Include circuit lengths required to install connected devices within 10 ft of location shown.
 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 shown as separate, combining them together in a single raceway is not permitted.
 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is permitted where not otherwise prohibited, except for the following:
 - a. Branch circuits fed from ground fault circuit interrupter (GFCI) circuit breakers.
 - b. Branch circuits with dimming controls.

- c. Branch circuits with isolated grounding conductor.
 - d. Branch circuits feeding computer or IT loads.
- B. Install products in accordance with manufacturer's instructions.
- C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- D. 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.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. 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.
- G. Install conductors with a minimum of 12 inches of slack at each outlet.
- H. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. 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 contaminants. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- K. 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.
 - 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.

- L. Insulate ends of spare conductors using vinyl insulating electrical tape.
- M. 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.
- N. 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.
- O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise. Keep splices in underground junction boxes, handholes, and manholes to an absolute minimum. Where splices are necessary, use resin pressure splices and resin splicing kits manufactured by the 3M Company to totally encapsulate the splice. Arrange the splicing kit to minimize the effects of moisture.
- P. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.

3.04 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD 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.
- D. Correct deficiencies and replace damaged or defective conductors and cables.
- E. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Grounding and bonding components.
- E. 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. Rod electrodes.

1.02 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.03 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide for grounding electrodes and connections.
- C. Project Record Documents: Record actual locations of components and grounding electrodes.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. 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.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
 - 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 19:
 - 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).
- 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.
 - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

2.03 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 5. Bonding Conductor: No. 4 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Rod Electrodes: Copper-clad steel.

2.04 CONNECTORS AND ACCESSORIES

- A. Mechanical Connectors: Bronze.
- B. Exothermic Connections:
 - 1. Cadweld or approved equal.
- 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.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2011.
- D. MFMA-4 - Metal Framing Standards Publication; Metal Framing Manufacturers Association; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 - 2. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated, where applicable.
 - 3. 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 _____. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

- b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 - 1. Comply with MFMA-4.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
- F. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

4. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 5. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

END OF SECTION 260529

SECTION 260534 - CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Aluminum rigid metal conduit (RMC).
- C. Intermediate metal conduit (IMC).
- D. PVC-coated galvanized steel rigid metal conduit (RMC).
- E. Flexible metal conduit (FMC).
- F. Liquidtight flexible metal conduit (LFMC).
- G. Electrical metallic tubing (EMT).
- H. Rigid polyvinyl chloride (PVC) conduit.
- I. Conduit fittings.
- J. Accessories.
- K. Conduit, fittings and conduit bodies.

1.02 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); National Electrical Contractors Association; 2006.
- G. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; National Electrical Contractors Association; 2004.
- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); National Electrical Contractors Association; 2003.
- I. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012 (ANSI/NEMA FB 1).
- J. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; National Electrical Manufacturers Association; 2005.
- K. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; National Electrical Manufacturers Association; 2003.
- L. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association; 2004.
- M. NFPA 70 - National Electrical Code; National Fire Protection Association; 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 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.
- Q. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- R. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- S. UL 651 - Schedule 40 and 80 Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- T. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- U. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.04 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
 - 3. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
 - 4. 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.
- D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
 - 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.
- J. Exposed, Exterior: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- L. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit or aluminum rigid metal conduit.
 - 1. Corrosive locations include, but are not limited to:
 - a. Cooling towers.
- M. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), aluminum rigid metal conduit, or PVC-coated galvanized steel rigid metal conduit.
- N. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
 - 1. Maximum Length: 6 feet.
- O. Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit.
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 - 3. Maximum Length: 6 feet unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

2.02 CONDUIT REQUIREMENTS

- A. 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 a mandrel through them.
- B. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- C. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4 inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
 - 3. Control Circuits: 1/2 inch (16 mm) 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 (27 mm) trade size.
- E. 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. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 3. Material: Use aluminum.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 INTERMEDIATE METAL CONDUIT (IMC)

- A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 3. Material: Use steel or malleable iron.
 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.
- C. All exposed conduit runs, fittings and supports in Building exteriors and interiors finished areas shall be painted to match the finish.
 - D. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
 - E. Do not install aluminum conduits in contact with concrete.

2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- C. PVC-Coated Fittings:
 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 4. Material: Use steel or malleable iron.
 5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
- D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.07 FLEXIBLE METAL CONDUIT (FMC)

- A. 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 to be used.
- B. Fittings:
 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings:
 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

2.09 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
3. 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.
4. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
5. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. 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.
- B. Fittings:
 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.

2.11 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
- D. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- 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.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.
- E. Install intermediate metal conduit (IMC) in accordance with NECA 101.

- F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
- G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- H. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Conceal all 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 conduits exposed:
 - 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 the shortest possible manner unless otherwise indicated. Route all 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 the equivalent of four 90 degree bends between pull points.
 - 9. Route conduits above water and drain piping where possible.
 - 10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 11. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 - 12. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
 - 13. Group parallel conduits in the same area together on a common rack.
- I. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 3. 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.
- 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 a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
 7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 8. Secure joints and connections to provide maximum 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. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 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. Include proposed locations of penetrations and methods for sealing with submittals.
 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, using materials and methods specified in Section 07 84 00.
- L. Underground Installation:
1. Provide trenching and backfilling None-N/A.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
- M. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete with minimum concrete cover of 3 inches on all sides unless otherwise indicated.
- N. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.
- 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.
 2. Where conduits are subject to earth movement by settlement or frost.
- P. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
 3. Where conduits penetrate coolers or freezers.
- Q. Provide pull string in all empty conduits 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.

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.
- 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 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 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. Only where approved, route exposed conduit parallel and perpendicular to walls.
- C. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic and expansion joints and between building and walkway covers.

3.06 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.07 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in plans and specifications.
- B. Route conduit through roof openings for piping and ductwork wherever possible; otherwise, route through roof jack with pitch pocket. Where separate roofing penetration is required, coordinate location and installation method with roofing installation.

END OF SECTION 260534

SECTION 260537 - BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Wall and ceiling outlet boxes.
- D. Floor boxes.
- E. Pull and junction boxes.

1.02 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012 (ANSI/NEMA FB 1).
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2008 (Revised 2010) (ANSI/NEMA OS 1).
- E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; National Electrical Manufacturers Association; 2008 (Revised 2010) (ANSI/NEMA OS 2).
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.03 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

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 by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
 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 suitable concrete type boxes where flush-mounted in concrete.
 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
 5. Use raised covers suitable for the type of wall construction and device configuration where required.
 6. Use shallow boxes where required by the type of wall construction.
 7. Do not use "through-wall" boxes designed for access from both sides of wall.
 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 10. 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.
 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
 12. Wall Plates: Comply with Section 26 27 26.
- 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:
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

2.02 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 2. EGS/Appleton Electric.
 3. Erickson Electrical Equipment Company.
 4. Hoffman.
 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 6. O-Z/Gedney; a unit of General Signal.
 7. RACO; a Hubbell Company.
 8. Robroy Industries, Inc.; Enclosure Division.

9. Scott Fetzer Co.; Adaiet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

2.03 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. Nonmetallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

2.04 FLOOR BOXES

- A. Floor Boxes: NEMA OS 1, fully adjustable, 1-1/2 inches deep.
- B. Material: Cast metal.
- C. Shape: Round.

2.05 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

2.06 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 1. Color of Frame and Cover: Gray.
 2. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 3. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 4. Cover Legend: Molded lettering, as indicated for each service.
 5. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 6. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Jensen.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. Utility Vault.

- e. Brooks.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 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. 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 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.
- E. Install boxes plumb and level.
- F. 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.
 - 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.
- G. Install boxes as required to preserve insulation integrity.
- H. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- I. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- J. Close unused box openings.
- K. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- L. Provide grounding and bonding in accordance with Section 26 05 26.
- M. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
- N. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.
- O. Set wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device.
- P. 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.
- Q. Maintain headroom and present neat mechanical appearance.
- R. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

- S. inaccessible Ceiling Areas: install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- T. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- U. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- V. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- W. Use flush mounting outlet box in finished areas.
- X. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- Y. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- Z. Locate outlet boxes so that wall plates do not span different building finishes.
- AA. Locate outlet boxes so that wall plates do not cross masonry joints.
- AB. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation.
 - 1. Provide minimum 24 inches separation in acoustic rated walls.
 - 2. Provide minimum 24 inches separation in fire rated walls.
- AC. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- AD. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- AE. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- AF. Use adjustable steel channel fasteners for hung ceiling outlet box.
- AG. Do not fasten boxes to ceiling support wires.
- AH. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- AI. Use gang box where more than one device is mounted together. Do not use sectional box.
- AJ. Use gang box with plaster ring for single device outlets.
- AK. Use cast outlet box in exterior locations exposed to the weather and wet locations.
- AL. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
- AM. Set floor boxes level.

3.02 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.

3.03 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

END OF SECTION 260537

SECTION 260553 - 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. Underground warning tape.
- E. Warning signs and labels.

1.02 REFERENCE STANDARDS

- A. ASTM D 709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.03 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.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.06 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. 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.
 - b. Motor Control Centers:
 - 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.
 - c. 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.
 - d. 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.
 - e. 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.
2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - 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.

- c. Use identification nameplate at each piece of service equipment to identify the available fault current and the date calculations were performed.
 - 3. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches.
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
- B. Identification for Conductors and Cables:
 - 1. 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.
 - 2. 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.
- C. Identification for Raceways:
 - 1. 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.
 - 2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
 - 3. Use underground warning tape to identify underground raceways.
- D. Identification for Boxes:
 - 1. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, use only identification labels.
- E. Identification for Devices:
 - 1. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
 - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
 - 2. 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.
- F. Buried Electrical Lines: Underground warning tapes.
- G. Communication Cabinets: Nameplates.
- H. Electrical Distribution and Control Equipment Enclosures: Nameplates.
- I. Junction Box Load Connections: Wire markers.
- J. Outlet Box Load Connections: Wire markers.
- K. Panel Gutter Load Connections: Wire markers.
- L. Pull Box Load Connections: Wire markers.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 - 1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 - 2. 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.
 - 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 5. 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. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - 2. 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. Equipment designation or other approved description.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 - b. Other Information: 1/4 inch.
 - 5. Color:
 - a. Normal Power System: White text on black background.
- D. 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.
- E. 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.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 3/16 inch.
 - 5. Color: Black text on clear background.
- F. 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.

2.03 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.
- G. Description: Vinyl cloth type self-adhesive wire markers.

2.04 UNDERGROUND WARNING TAPE

- A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
 - 1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.
- B. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- C. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- D. Legend: Type of service, continuously repeated over full length of tape.
- E. 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.

2.05 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. 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.
- C. 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.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

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: Inside of equipment door.
 - 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.
- 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.
- 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 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.

1.02 REFERENCE STANDARDS

- A. 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; 2010.
- B. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2004 (R2010).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; 2010.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.
- F. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Fluorescent Ballasts; National Electrical Manufacturers Association; 2011.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 773 - Plug-in Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
- I. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
- J. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- K. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

1.03 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. Notify Architect 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.

1.04 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.
- C. Field Quality Control Reports.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.06 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.

1.07 FIELD CONDITIONS

1.08 WARRANTY

- A. Provide five year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.01 ALL LIGHTING CONTROL DEVICES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.02 OCCUPANCY SENSORS

- A. 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/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic 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.
 - 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. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on the drawings.
- B. 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 the 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. 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.
 2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- C. 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 the 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/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 1000 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
- D. 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 the drawings.
 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 4. Load Rating: As required to control the load indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- 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 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. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 37 as required for installation of lighting control devices provided under this section.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. 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.
- G. Occupancy Sensor Locations:
 - 1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
 - 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.

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. 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 Architect.

- C. 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.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

END OF SECTION 260923

SECTION 262717 - EQUIPMENT WIRING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
- B. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R2008).
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 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.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to 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.
- B. Disconnect Switches: As specified in Section 16412 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 34.

- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 37.

2.02 EQUIPMENT CONNECTIONS

PART 3 EXECUTION

3.01 EXAMINATION

- A. 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.
- 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.

END OF SECTION 262717

SECTION 262726 - WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.
- E. Floor box service fittings.
- F. Poke-through assemblies.
- G. Access floor boxes.

1.02 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; 2010.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
- F. NEMA WD 6 - Wiring Device -- Dimensional Specifications; National Electrical Manufacturers Association; 2002 (R2008).
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; 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-Interruption; Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.03 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 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.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hubbell Incorporated;; www.hubbell-wiring.com.
- B. Leviton Manufacturing Company, Inc;; www.leviton.com.
- C. Pass & Seymour, a brand of Legrand North America, Inc;; www.legrand.us
- D. Arrow
- E. Approved equal.
- F. Source Limitations: Where possible, for each type of wiring device furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 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.
- C. Provide weather resistant GFI receptacles with specified weatherproof covers for all receptacles installed outdoors or in damp or wet locations.
- D. Provide GFI protection for all receptacles installed within 6 feet of sinks.
- E. Provide GFI protection for all receptacles installed in kitchens.
- F. Provide GFI protection for all receptacles serving electric drinking fountains.
- G. Provide isolated ground receptacles for all receptacles serving computers.
- H. Unless noted otherwise, do not use combination switch/receptacle devices.
- I. For flush floor service fittings, use tile rings for installations in tile floors.
- J. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.03 ALL WIRING DEVICES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- B. Coordinate color of finish, style and device face plate color with Architect prior to ordering devices.

2.04 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
- B. All Wall Switches: 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.
- C. 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.

2.05 WALL DIMMERS

- A. Manufacturers:
 - 1. Leviton Manufacturing Company, Inc: www.leviton.com.
 - 2. Lutron Electronics Company, Inc: www.lutron.com.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
- B. All Wall Dimmers: 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.
- C. Incandescent Wall Dimmers: 120 V AC, slide control type with separate on/off switch; single pole or three way as indicated on the drawings.
 - 1. Power Rating: 1000 W unless otherwise indicated or required to control the load indicated on the drawings.
- D. Magnetic Low-Voltage Wall Dimmers: 120 V AC, slide control type with separate on/off switch; single pole or three way as indicated on the drawings.
 - 1. Power Rating: 1000 VA unless otherwise indicated or required to control the load indicated on the drawings.
- E. Electronic Low-Voltage Wall Dimmers: 120 V AC, slide control type with separate on/off switch; single pole or three way as indicated on the drawings.
 - 1. Power Rating: 400 VA unless otherwise indicated or required to control the load indicated on the drawings.
- F. Fluorescent Wall Dimmers: 120 V AC, slide control type with separate on/off switch, compatible with dimming ballast controlled; single pole or three way as indicated on the drawings.
 - 1. Power Rating: 1000 VA unless otherwise indicated or required to control the load indicated on the drawings.

2.06 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
- B. All Receptacles: 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.
- C. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 - 2. Isolated Ground Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; single or duplex as indicated on the drawings.
 - 3. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R,, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
- D. GFI Receptacles:
 - 1. All GFI Receptacles: Provide with feed-through protection, light to indicate ground fault tripped condition and loss of protection, and list as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 - 2. Standard GFI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 - 3. Weather Resistant GFI 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 SE suitable for installation in damp or wet locations.

2.07 WALL PLATES

- A. All Wall Plates: Comply with UL 514D.
 - 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.
- B. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

2.08 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
 - 1. Wiremold, a brand of Legrand North America, Inc: www.legrand.us
- B. Description: Service fittings compatible with floor boxes provided under Section 26 05 37 with all components, adapters, and trims required for complete installation.
- C. Flush Floor Service Fittings:
 - 1. Dual Service Flush Combination Outlets:
 - a. Cover: Rectangular.

- b. Configuration:
 - 1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).
 - 2) Communications:.
- 2. 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).

2.09 POKE-THROUGH ASSEMBLIES

- A. Manufacturers:
 - 1. Wiremold, a brand of Legrand North America, Inc: www.legrand.us
- B. 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.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- 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.
- 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 a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 37 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.
 - b. Wall Dimmers: 48 inches above finished floor.

- c. Receptacles: 18 inches above finished floor or 6 inches above counter.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Provide minimum of 24 inches horizontal separation between flush mounted outlet boxes installed on opposite sides of fire rated walls.
 - 4. 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.
 - 5. Provide separate outlet boxes for wiring devices connected to emergency power and normal power systems.
 - 6. Unless otherwise indicated, provide separate outlet boxes for line voltage and low voltage devices.
 - 7. 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 Architect to obtain direction prior to proceeding with work.
 - 8. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
 - 9. Locate outlet boxes so that wall plate does not span different building finishes.
 - 10. Locate outlet boxes so that wall plate does not cross masonry joints.
- C. Install wiring devices in accordance with manufacturer's instructions.
 - D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
 - E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
 - F. 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.
 - G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - H. 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.
 - I. Provide GFI receptacles with integral GFI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
 - J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
 - K. Install wall switches with OFF position down.
 - L. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
 - M. Do not share neutral conductor on branch circuits utilizing wall dimmers.
 - N. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
 - O. 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.
 - P. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
 - Q. 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.
 - R. Install poke-through closure plugs in all unused core holes to maintain fire rating of floor.

3.04 FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.
- B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- C. Test each receptacle to verify operation and proper polarity.
- D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 262726

SECTION 265100 - INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Fluorescent dimming ballasts and controls.
- F. Fluorescent emergency power supply units.
- G. Lamps.
- H. Luminaire accessories.

1.02 REFERENCE STANDARDS

- A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns; 2006.
- B. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast; 2004.
- C. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type); 2002.
- D. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements; 2011.
- E. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (R2008).
- F. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- H. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association; 2006.
- I. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association; 2006.
- J. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; National Electrical Manufacturers Association; 2011.
- K. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; National Electrical Manufacturers Association; 2012.
- L. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R2008).
- M. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. NFPA 101 - Life Safety Code; National Fire Protection Association; 2012.
- O. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

- P. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.
- Q. UL 1029 - High-Intensity-Discharge Lamp Ballasts; 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.

1.03 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 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 of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. ANSI/CEC - National Electrical Code.
- C. ANSI/NFPA 101 - Life Safety Code.
- D. Title-24 C.C.R.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate dimensions and components for each fixture that is not a standard product of the manufacturer.
- B. 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. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
 - 2. Ballasts: Include wiring diagrams and list of compatible lamp configurations.
 - 3. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
 - 4. Fluorescent Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.
- C. Samples:
 - 1. Provide one sample(s) of each luminaire proposed for substitution upon request.
- D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.
- 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 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 Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
 - 4. Extra Ballasts: 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.

1.05 QUALITY ASSURANCE

- A. Conform to 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.

1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.07 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide two year manufacturer warranty for all linear fluorescent ballasts.
- C. Provide five year pro-rata warranty for batteries for emergency lighting units.
- D. Provide ten year pro-rata warranty for batteries for self-powered exit signs.
- E. Provide three year full warranty for fluorescent emergency power supply units.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- D. 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.
- E. 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.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
 - 2. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
 - 3. Air-Handling Recessed Fluorescent Luminaires: Suitable for air supply/return, heat removal, or combination as indicated.
- H. Fluorescent Luminaires:
 - 1. Provide ballast disconnecting means complying with NFPA 70 where required.
 - 2. Fluorescent Luminaires Controlled by Occupancy Sensors: Provide programmed start ballasts.
 - 3. Fluorescent Luminaires Controlled by Dual-Level Switching: Provide with stepped-dimming ballast.

2.03 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
 - 1. Sealed maintenance-free lead calcium unless otherwise indicated.
 - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. Accessories:
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.

2.04 FIXTURE TYPES

- A. Furnish products as indicated in Schedule included on the Drawings.

2.05 EXIT SIGNS

- A. Description: Exit signs and similar signs for special purpose applications such as area of refuge/rescue assistance.
- B. All Exit Signs: Internally illuminated with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single or double as indicated or as required for the installed location.
 - 2. Directional Arrows: As indicated or as required for the installed location.
- C. Exit Signs: Exit sign fixture suitable for use as emergency lighting unit.
 - 1. Provide fixtures complying with NFPA 101.
 - 2. Lamps: LED.
 - 3. Mounting: As indicated.

2.06 BALLASTS AND DRIVERS

- A. All Ballasts:
 - 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.
- B. Fluorescent Ballasts:
 - 1. All Fluorescent Ballasts: Unless otherwise indicated, provide high frequency electronic ballasts complying with ANSI C82.11 and listed and labeled as complying with UL 935.
 - a. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 10 percent.
 - b. Total Harmonic Distortion: Not greater than 10 percent.
 - c. Power Factor: Not less than 0.95.
 - d. Ballast Factor: Normal ballast factor between 0.85 and 1.15, unless otherwise indicated.
 - e. Thermal Protection: Listed and labeled as UL Class P, with automatic reset for integral thermal protectors.
 - f. Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
 - g. Lamp Compatibility: Specifically designed for use with the specified lamp, with no visible flicker.
 - h. Lamp Operating Frequency: Greater than 20 kHz, except as specified below.
 - 1) Do not operate lamp(s) within the frequencies from 30 kHz through 40 kHz in order to avoid interference with infrared devices.
 - i. Lamp Current Crest Factor: Not greater than 1.7.
 - j. Lamp Wiring Method:
 - 1) Instant Start Ballasts: Parallel wired.
 - 2) Rapid Start Ballasts: Series wired.
 - 3) Programmed Start Ballasts: Provide parallel or series/parallel wired where available; otherwise series wired is acceptable.
 - k. Provide automatic restart capability to restart replaced lamp(s) without requiring resetting of power.
 - l. Provide end of lamp life automatic shut down circuitry for T5 and smaller diameter lamp ballasts.
 - m. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.
 - n. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 18, for Class A, non-consumer application.
 - o. Ballast Marking: Include wiring diagrams with lamp connections.
 - 2. Non-Dimming Fluorescent Ballasts:

- a. Lamp Starting Method:
 - 1) T8 Lamp Ballasts: Instant start unless otherwise indicated.
 - 2) T5 Lamp Ballasts: Programmed start unless otherwise indicated.
 - 3) Compact Fluorescent Lamp Ballasts: Programmed start unless otherwise indicated.
- b. Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of 0 degrees F, and energy saving lamp(s) at a minimum of 60 degrees F unless otherwise indicated.
- 3. Dimming Fluorescent Ballasts:
 - a. Dimming Range: Continuous dimming from 100 percent to one percent relative light output unless dimming capability to lower level is indicated, without flicker and with even tracking across multiple lamps.
 - b. Control Compatibility: Fully compatible with the dimming controls to be installed.
 - c. Lamp Starting Method: Programmed start unless otherwise indicated.
 - d. Lamp Starting Temperature: Capable of starting lamp(s) at a minimum of 50 degrees F.
 - e. Dimmed Lamp Starting: Capable of starting lamp(s) at any dimmed preset without transitioning first to full light output.
- 4. Bi-Level Stepped Dimming Linear Fluorescent Ballasts:
 - a. Bi-Level Operation: Capable of being switched between full light output on all lamps, 50 percent of full light output on all lamps, and all lamps off.
 - b. Control Compatibility: Capable of being controlled by standard manual light switches or occupancy sensors unless otherwise indicated.
 - c. Lamp Starting Method: Programmed start unless otherwise indicated.
 - d. Lamp Starting Temperature: Capable of starting lamp(s) at a minimum of 50 degrees F.
- C. High Intensity Discharge (HID) Ballasts: Complying with ANSI C82.4 and listed and labeled as complying with UL 1029.
 - 1. Electronic Metal Halide Ballasts:
 - a. All Electronic Metal Halide Ballasts:
 - 1) Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 10 percent.
 - 2) Total Harmonic Distortion: Not greater than 15 percent.
 - 3) Power Factor: Not less than 0.90.
 - 4) Provide thermal protection with automatic reset.
 - 5) Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
 - 6) Lamp Operating Frequency: Less than 200 Hz or as required to avoid acoustic resonance in lamp arc tube.
 - 7) Lamp Current Crest Factor: Not greater than 1.5.
 - 8) Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of -22 degrees F.
 - 9) Provide end of lamp life automatic shut down circuitry.
 - 10) Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.
 - 11) Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 18, for Class A, non-consumer application.

2.07 FLUORESCENT EMERGENCY POWER SUPPLY UNITS

- A. Description: Self-contained fluorescent emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

- B. Compatibility:
 1. Ballasts: Compatible with electronic, standard magnetic, energy saving, and dimming AC ballasts, including those with end of lamp life shutdown circuits.
 2. Lamps: Compatible with low-mercury lamps.
- C. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the fluorescent emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- D. Battery: Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated.
- E. Emergency Illumination Output:
 1. Luminaires with F32T8 Lamps: Operate two lamp(s) at a minimum of 1350 lumens unless otherwise indicated with indicated illumination evenly divided between the lamps.
 2. Luminaires with F28T5 Lamps: Operate one lamp(s) at a minimum of 1325 lumens unless otherwise indicated.
 3. Luminaires with F54T5HO Lamps: Operate one lamp(s) at a minimum of 1250 lumens unless otherwise indicated.
- F. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.
- G. Operating Temperature: From 32 degrees F to 122 degrees F unless otherwise indicated or required for the installed location.
- H. Accessories:
 1. Include TEST switch and AC ON indicator light, installed to be operable and visible integral to fixture.

2.08 LAMPS

- A. Manufacturers:
 1. General Electric Company/GE Lighting;: www.gelighting.com.
 2. Osram Sylvania;: www.sylvania.com.
 3. Philips Lighting Company;: www.lighting.philips.com.
 4. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
 5. 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. All Lamps:
 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
 3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
 4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.
- C. Compact Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
 1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
 2. Correlated Color Temperature (CCT): 4,100 K unless otherwise indicated.
 3. Color Rendering Index (CRI): Not less than 80.
 4. Average Rated Life: Not less than 10,000 hours for an operating cycle of three hours per start.

- D. Linear Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
 - 1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
 - 2. T8 Linear Fluorescent Lamps:
 - a. Correlated Color Temperature (CCT): 4,100 K unless otherwise indicated.
 - b. Color Rendering Index (CRI): Not less than 80.
 - c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.
 - 3. T5 Linear Fluorescent Lamps:
 - a. Correlated Color Temperature (CCT): 4,100 K unless otherwise indicated.
 - b. Color Rendering Index (CRI): Not less than 80.
 - c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.
- E. High Intensity Discharge (HID) Lamps: Wattage as indicated, with bulb type, burning position, and base type as required for luminaire.
 - 1. Metal Halide Lamps:
 - a. Non-Reflector Type Metal Halide Lamps: Phosphor coated lamp finish unless otherwise indicated.
 - b. Provide ANSI type O-rated protected metal halide lamps where required for open luminaires provided with compatible exclusionary sockets.
 - c. Ceramic Metal Halide Lamps:
 - 1) Correlated Color Temperature (CCT): 4,000 K unless otherwise indicated.
 - 2) Color Rendering Index (CRI): Not less than 80.
- F. Lamp Types: As specified for each fixture.

2.09 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.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- 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 37 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), and NECA 502 (industrial lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. 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 pendant-mounted luminaires to building structure.
 - 4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 5. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
 - 6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- F. 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.
- G. 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.
- H. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- I. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 and 502.
- J. Surface Mounted Fixtures: Install plumb and square and aligned with building lines and with each other; secure to prevent movement.
- K. Wall Mounted Fixtures: Install at height as indicated on the drawings.
- L. Install accessories furnished with each luminaire.
- M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within fixture.
- N. Bond products and metal accessories to branch circuit equipment grounding conductor.
- O. Air Handling Luminaires: Interface with air handling accessories furnished and installed under Section 23 36 00.
- P. Fluorescent Luminaires Controlled by Dual-Level Switching: Connect such that each switch controls the same corresponding lamps in each luminaire.
- Q. Emergency Lighting Units:

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.
- R. 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.
- S. Fluorescent Emergency Power Supply Units:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal ballast(s) in luminaire. Bypass local switches, contactors, or other lighting controls.
- T. Remote Ballasts: 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.
- U. Install lamps in each luminaire.
- V. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- W. Install in accordance with manufacturers instructions.
- X. Install specified lamps in each luminaire, emergency lighting unit and exit sign.
- Y. Verify all ceiling types and provide lighting fixtures with suitable mounting hardware for mounting in or on subject ceiling.
- Z. Surface Mounted Fluorescent Fixtures: Where fixtures are indicated for installation on low-density cellulose fiberboard (see room finish schedule on drawings), provide 1-1/2" insulation, unless UL approved for mounting directly to the ceiling material.
- AA. Properly support and align fixtures and provide all necessary steel shapes for support of the fixtures. Coordinate complete fixture installation with the building construction.
- AB. Where special fixtures to be used in special ceiling are scheduled, verify all ceiling systems and coordinate fixture type and accessories prior to ordering fixtures. Coordinate and cooperate with ceiling supplier in the preparation of ceiling system Shop Drawings.
- AC. Install fluorescent fixtures as recommended by the manufacturer or as necessary to provide exact horizontal alignment, preventing horizontal or vertical deflection on angular jointing of fixtures suspended in continuous rows.
- AD. Two-lamp ballasts shall be allowed to feed single lamps in tandem fixtures and shall be properly identified to show which lamps are fed from this ballast by markers on the fixture and the ballast. Provide the quantity and type of ballasts required to achieve switching configuration indicated on the drawings.

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, emergency lighting units, and fluorescent emergency power supply units 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 Architect.
- F. Each fluorescent fixture when initially energized shall be left on continuously for 100 consecutive hours to properly burn in fluorescent lamps.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. 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 Architect or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.
- D. Aim and adjust fixtures as indicated.
- E. 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 photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- C. 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 265100