

**HART MIDDLE SCHOOL
NEW SCIENCE BUILDING
INCREMENT 2**

PROJECT MANUAL

CONTRACT NUMBER: _____

PLEASANTON UNIFIED SCHOOL DISTRICT

_____, 2021

SPECIFICATIONS
SFA Project No. 20008.03

**NEW SCIENCE BUILDING
INCREMENT 2
THOMAS S. HART MIDDLE SCHOOL**

PLEASANTON UNIFIED SCHOOL DISTRICT
Alameda County, California



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DSA File No. 01-32
DSA Application No. 01-119271

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PLEASANTON UNIFIED SCHOOL DISTRICT
Alameda County, California

Division of the State Architect
Office of Regulation Services

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Factory-formed and field-assembled, concealed-fastener, lap-seam metal roof panels.

1.3 DEFINITIONS

- A. Metal Roof and Siding Panel Assembly: Metal roof and siding panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.
- B. Preformed roofing and siding is hereby defined to include panels which are structurally capable of spanning between supports spaced as indicated.

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel, soffit panel, and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal roof and soffit panels; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the registered structural engineer responsible for their preparation.

- C. Samples for Initial Selection: For each type of metal wall panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
 - 2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Roof Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal wall panel accessories.
 - 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 - 3. Accessories: 12-inch- long Samples for each type of accessory.
- E. Qualification Data: For Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- G. Field quality-control reports.
- H. Maintenance Data: For metal roof and soffit panels to include in maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Comply with Section 1503A, Title 24, Part 2, C.C.R.
- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal roof panels and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Preliminary Roofing Conference: Before starting roof sheathing construction, conduct conference at Project site. Comply with requirements for preinstallation conferences in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roof sheathing construction and metal roof panels.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal roof panel assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal panels from exposure to sunlight and high humidity, except to extent necessary for period of metal panel installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where final field measurements cannot be reasonably made, either establish framing and opening dimensions and proceed with fabricating metal roof panels without field measurements, or allow for field-trimming of panels. Coordinate roof construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations, which are specified in Division 7 Section "Roof Accessories."
- B. Coordinate metal panel roof assemblies with rain drainage work, flashing, trim, and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

(Project close-Out Item)

- A. Manufacturer's Warranty: Manufacturer's standard 25-year performance warranty, stating the following:
 - 1. Architectural fluorocarbon finish:
 - a. Will be free of fading or color change in excess of 5 Hunter delta-E units as determined by ASTM D2244-02.

- b. Will not chalk in excess of numerical rating of 8 when measured in accordance with standard procedures specified in ASTM D4214-98 method D659.
 - c. Will not peel, crack, chip, or delaminate. 2. Metal substrate will not rupture, fail structurally, or perforate.
- B. Installer's Warranty: Roofing Guarantee covering work of this section including roofing, underlayment, roof insulation and roofing accessories, signed and countersigned by Installer (Roofer) and Contractor.
- 1. Warranty Period: 2 years from date of Substantial Completion.
- C. Weathertight Performance Warranty: Manufacturer's standard warranty in which manufacturer agrees to repair or replace metal roof panel assemblies that fail to remain weather tight within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
- 1. Products: Subject to compliance with requirements, provide one of the products specified, or preapproved equal.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified, or preapproved equal.

2.2 UNDERLAYMENT MATERIALS

- A. Underlayment: HPR aquashield, Peel and Stick Membrane or approved equal.

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.
- 1. Fasteners for Roof Panels: Self-drilling or self-tapping 410 stainless or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal roof panels.
 - 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 CONCEALED-FASTENER, LAP-SEAM METAL ROOF PANELS

- A. General: provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Standing-Seam-Profile, Concealed-Fastener Metal Roof Panels: Provide structural standing seam metal roof system with a min. 1-3/4" high "vertical" seam, side joint, snap-together seam, with factory applied sealant.
 - 1. Manufacturers:
 - a. AEP Span, a Division of ASC Profiles, Inc.; Preformed Metal Standing Seam Roofing – SpanSeam (SPS2216)
 - b. Or approved equal.
 - 2. Materials:
 - 3. Metal Panels: Steel conforming to ASTM A792.
 - a. 22 Gauge: Yield strength 50,000 psi; with aluminum-zinc alloy coating conforming to ASTM A792, Class AZ50.
 - b. Thickness and yield strength as required for performance indicated; with aluminum-zinc alloy coating conforming to ASTM A792, Class AZ50 For projects with multiple profiles or varied combinations of profiles, rib patterns and finishes, show on Drawings.
 - 4. Panel Width and Pattern:
 - a. 16-inch panel width, flat pan.
 - 5. Panel Seam Height: 2 inches.
Dimensions are approximate.
 - 6. Panel Finish: Provide primer and top finish coat on exposed faces; provide primer and backer coat on concealed faces of panels.
 - a. DuraTech® 5000: Polyvinylidene Fluoride, full 70 percent Kynar 500® or Hylar 5000®, consisting of a baked-on 0.15-0.20 mil corrosion resistant primer and a baked-on 0.70-0.80 mil finish coat with a specular gloss of 8 to 15 when tested in accordance with ASTM D523 at 60 degrees.
 - b. Panel Color: As selected from manufacturer's full range.
 - 7. Seam Sealant: Factory apply high-grade butyl mastic sealant within the confines of panel's female leg, designed to seal against adjacent male panel leg.
 - a. Material for flashing and trim: Fabricate in profiles indicated on drawings of same material, thickness, and finish as wall panel system, unless indicated otherwise.

2.5 ACCESSORIES

- A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
1. Closures: Precut form profile closures shall be cut from a black closed cell foam meeting specification ASTM D 1056 grade SCE 41 Black EPT. Field fabricate hip closures shall be gray PVC foam. All hip and ridge closures shall be supported and protected from weathering by a metal channel matching the roof and flashing.
 2. Clips: Roof anchor clips are designated as #2080 heavy base hook clip. The hook shall be Type 301 stainless steel and base material galvanized steel. Clips shall be designed to allow for expansion and contraction of the roof relative to the structure throughout the temperature range specified.
 3. Screws: Screws holding anchor clips shall be minimum of #14 HEX head. Length of anchor screws shall be sufficient to meet the design loads of the project with a suitable factor of safety for the material involved. (NFPA, AISI)
 4. Exposed fasteners shall be cadmium plated and color matched. For weather-tightness, screws shall have separate washers with hot bonded neoprene faces and pop rivets shall be set in set sealant. Exposed fasteners shall be a minimum #14 screw or 3/16 inch diameter rivet. Wherever possible, exterior fasteners shall be located so that leakage does not run directly inside the structure.
 5. Furnish and install foam polyethelene rod and rib closures at all exposed and semi-exposed standing seam ribs at eave conditions.
 6. Exposed Sealant: Exposed sealant shall be curing elastomeric type with excellent weather and sunlight resistance. Color shall match the prefinished exterior metal. Sealant shall be applied in accordance with the manufacturer;s recommendations.
 7. Concealed Sealant: Concealed sealant shall be a non-curing polyisobutylene tape of sufficient thickness to make full contact with both surfaces.
- B. Flashing and Trim: Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels. Minimum inside bend radius on all flashing shall be 3T and all edges shall have an open hem for stiffness.
- C. Gutters: Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced 36 inches o.c., fabricated from same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at outlets. Finish gutters to match metal roof panels.
- D. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- E. Gutter Liner and Bonding Adhesive: 50 mil. KEE with bonding adhesive by Commercial Innovations, or approved equal.

2.6 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill

indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

2.7 FINISHES, GENERAL

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.
 - 1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

2. For the record, prepare written report, to the Architect, endorsed by Installer, listing conditions detrimental to performance of work.

- B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
- B. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
- C. Install fasciae and copings to comply with requirements specified in Division 7 Section.

3.3 UNDERLAYMENT INSTALLATION

- A. Peel and Stick Underlayment: Install underlayment on plywood sheathing under metal roof panels, unless otherwise recommended by metal roof panel manufacturer. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal roof panels. Apply at locations indicated below and on Drawings, in shingle fashion to shed water, with lapped joints of not less than 2 inches.
 - 1. Apply from eave to ridge.
- B. Install flashings to cover underlayment to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
- C. Apply slip sheet over underlayment before installing metal roof panels.

3.4 METAL ROOF PANEL INSTALLATION, GENERAL

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cutting of metal roof panels by torch is not permitted.
 - 2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels.
 - 3. Provide metal closures at peaks, rake edges, rake walls and each side of ridge and hip caps.
 - 4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 - 5. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 6. Install ridge and hip caps as metal roof panel work proceeds.

7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
8. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:

1. Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

1. Coat back side of aluminum roof panels with bituminous coating where roof panels will contact wood, ferrous metal, or cementitious construction.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.5 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.
- E. Gutter Liner: Prime metal and fully adhere a continuous gutter liner.

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform inspections and prepare reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed metal roof panel installation, including accessories. Report results in writing.
- C. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On

completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 40 00

(3/21)

SECTION 07 45 00 MINERAL-FIBER-REINFORCED CEMENTITIOUS PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiber cement panels
- B. Cladding attachment system.

1.2 REFERENCES

References are product specific.

- A. ASTM - ASTM International:
 - 1. ASTM C1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber- Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards.
 - 2. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets.
 - 3. ASTM E84 - Surface Burning Characteristics of Building Materials.
 - 4. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750-degree C. Determination of Non-Combustibility.
- B. CEN - European Committee for Standardization:
 - 1. EN 12467 - Fiber Cement Flat Sheets-Product Specifications and Test Methods.
 - 2. EN 13501 - Fire Test to Building Material.
 - 3. EN 20105 - Test for Color Fastness.
 - a. Part A02 Grey Scale.
- C. ULC - National Standard of Canada
 - 1. CAN/ULC S102 - Surface Burning Characteristics of Building Materials and Assemblies
 - 2. CAN/ULC S114 - Standard Method of Test for Determination of Non-Combustibility in Building Materials
- D. ICC – International Code Council
 - 1. ICC-ES Evaluation Report: ESR-3863 Cembrit Fiber-Cement Façade Panel System
- E. IAPMO - The International Association of Plumbing and Mechanical Officials
 - 1. IAPMO-UES Evaluation Report: 553 Cembrit Fiber-Cement Façade Panel System
- F. Materials and Equipment Acceptance (MEA) - New York City Department of Buildings Division.

1.3 SUBMITTALS

- A. Submit under provisions of Division 1 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Shop Drawings: Provide detailed drawings of non-standard applications of fiber cement materials which are outside the scope of the standard details and specifications provided by the manufacturer.
- D. Attachment System Engineered Drawings:
1. Provide engineered design for attachment and back-up framing to support exterior cladding.
 2. Provide static calculations verifying sizing of members, attachment devices and fasteners to support the exterior cladding with a safety factor required by Authority Having Jurisdiction (AHJ).
 3. Provide Installation drawings and details.
- E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum of 2 years experience with installation of similar products.
- B. Color Evaluation: Insignificant change after 3000 hours of QUV test (EN 20105).
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 3. Remodel mock-up area as required to produce acceptable work.

1.5 FABRICATION, DELIVERY, STORAGE, AND HANDLING

- A. All cladding materials to be finished and fabricated in the United States with backup inventory in residence in the United States to support job in-progress.
- B. Store products in manufacturer's unopened packaging until ready for installation in accordance with manufacturer's recommended guidelines.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.7 WARRANTY

- A. Warranty: Manufacturer warrants that its products are manufactured in accordance

with its applicable material specifications and are free from defects in materials and workmanship.

1. Only products that are installed and used in accordance with applicable manufacturer's instructions and specifications are warranted.
2. The warranty is applicable only to claims made in writing and received by the manufacturer within thirty days after the defect was discovered and within ten years after the date of the shipment of the product by the manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURER/SUPPLIER

- A. Basis of Design: AFC Cladding Fiber Cement Panels by American Fiber Cement Corp.;
6901 S. Pierce St. Suite 180, Littleton, CO 80128. ASD. Toll Free Tel: (800) 688-8677 ext.
102. Tel: (303) 978-1199. Fax: (303) 978-0308. Email: danglada@afcccladding.com. Web: <http://www.americanfibercement.com>.
- B. Requests for substitutions will be considered in accordance with provisions of Division 1- Product Requirements.

2.2 THROUGH COLOR HIGH DENSITY FIBER CEMENT PANELS

1. Product: Cembrit Patina Inline
 - a. Application: Exterior
 - b. Thickness: 5/16 inch (8 mm) groove, 3/8 inch (9.5mm)Top
 - c. Surface: Milled Grooves
 - d. Length: 96 inch (2500 mm), & 120 inch (3050mm)
 - e. Width: 48 inch (1192 mm)
 - f. Weight: 2.5 lbs/sq. ft.
 - g. Colors: to be selected from manufacturer standard colors
 - 1)PI 020 (Granite).
 - 2)PI 050 (Graphite).
 - 3)PI 070 (Flint).
 - 4)PI 222 (Pearl).
 - 5)PI 545 (Sand).
 - h. ICC-ES Evaluation Report:
 - 1) ESR-3863 Cembrit Fiber-Cement Façade Panel System
 - i. Physical Characteristics: ASTM C1185/C1186, EN 12467 'Fiber-cement flat sheets

2.3 THROUGH COLOR HIGH DENSITY FIBER CEMENT PANELS

1. Product: Cembrit Solid
 - a. Application: Exterior.
 - b. Thickness: 5/16" (8 mm).

- c. Width: 48"
- d. Length: 96" and 120"
- e. Weight: 2.9 lbs/sq. ft.
- f. Finish: Through-colored fully covered 100% acrylic, muted, matte finish with a unique weather-proof treatment which makes it resistant to staining and surface dirt.
- g. Color: to be selected from Manufacturer Standard Colors
- h. Physical Characteristics: ASTM C1185/C1186, EN 12467 'Fiber-cement flat sheets'.
- i. ICC-ES Evaluation Report:
 - 1) ESR-3863 Cembrit Fiber-Cement Façade Panel System

2.4 MISCELLANEOUS CLADDING MATERIALS

- A. Building Wrap: AFCC Building Wrap complying with local codes for product and installation requirements.
- B. Aluminum Joint Closures and Decorative Corner Profiles: Manufacturer's standard products as detailed. Maximum thickness of finishing profile to be 0.8 mm or 21-gauge.

2.5 ATTACHMENT SYSTEMS

- A. Attachment System, Steel Supporting Members:
 - 1. Product: "Hat" or "Z" profiles supplied by others.
 - a. Material: Steel, minimum 16-gauge, minimum G90 coating.
 - 2. UV Protective Membrane: As supplied by American Fiber Cement Corp.
 - a. For open joint ventilated rain screen systems.
- B. Attachment System, Aluminum Supporting Members:
 - 1. Product: "Hat" or "Z" profiles supplied by others.
 - a. Material: Aluminum - min. 2mm thickness.
 - 2. UV Protective Membrane: As supplied by American Fiber Cement Corp.
 - a. For open joint ventilated rain screen systems.
- C. Attachment System, Wood Supporting Members:
 - 1. Product: Wood profiles supplied by others.
 - a. Material: Pressure treated wood.
 - 2. UV Protective Membrane: As supplied by American Fiber Cement Corp.
 - a. For open joint ventilated rain screen systems.

2.6 FIXING ACCESSORIES FOR ATTACHMENT SYSTEMS

- A. Rivets: Color-matched stainless-steel Astro rivets (for use with metal supporting members).
 - 1. As supplied by American Fiber Cement Corp.

- B. Screws: Color-matched stainless-steel screws (for use with wood supporting members).
 - 1. As supplied by American Fiber Cement Corp.
- C. Concealed Attachment, Epoxy Adhesive System: For concealed fastening of exterior cladding panels on ventilated rain screen constructions.
 - 1. Product: Dynamic Bond as manufactured by Dynamic Bonding Systems and supplied by American Fiber Cement Corporation.
 - a. Material: Structural adhesive and sealant based on MS-hybrid-polymer.
 - b. Physical Characteristics:
 - 1) Density: 1.54 g/cm³.
 - 2) Tensile strength: 2.3 N/mm².
 - 3) Shear strength: 2.1 N/mm².
 - 4) Fire reaction (EN 13501-1): B-s1-d0.
 - 2. Accessories:
 - a. Dynamic Clean: For use in conjunction with Dynamic Bond.
 - b. Dynamic Tape: For use in conjunction with Dynamic Bond.
 - c. Dynamic Protect: For impregnation of wood surfaces.
 - d. Dynamic SI Epoxy: For impregnation of porous (fiber) cement panels.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved submittals.
- B. For exterior applications, comply with local codes and structural engineer's fastening calculations along with manufacturer's recommendations for fastener spacing.

3.4 EXTERIOR CLADDING FOR RAINSCREEN APPLICATIONS

- A. Detailing Requirements:
 - 1. Air space at top and bottom of building or wall termination shall be 3/4 inch (20 mm) to facilitate airflow from behind the panels. Do not block vertical airflow at windows, doors, eaves, or at the base of the building. Airflow shall be

continuous from bottom to top so there is air movement behind each panel. For walls over 60 feet high (18 m), the ventilated cavity between rear of panels and exterior wall shall be increased to 1- 5/8 inches (40 mm). Air flow behind the cement fiber panels is critical to the performance of the rain screen constructions.

2. Fasteners in profile shall accommodate thermal expansion/contraction of metal and not interfere with panel application.
 3. Install panels from top of building to bottom.
 4. For straight walls, start panel installation in center and work outward.
 5. For walls with inside corners, start installation at corner and work across wall.
 6. Pattern: Straight pattern with vertical panels. Panel size as indicated.
 7. Pattern: Straight pattern with horizontal panels. Panel size as indicated.
 8. Pattern: Semi pattern with horizontal panels. Panel size as indicated.
- B. Rain Screen Installation: Comply with manufacturer's installation requirements.
1. Attachment System: Comply with manufacturer's engineered design for cladding support framing.

3.5 PROTECTION

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

END OF SECTION

(sfa 4/21)

SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Exterior and interior aluminum-framed storefronts (window walls).
 - a. Glazing is retained mechanically with gaskets on four sides, unless otherwise indicated.

1.3 REQUIREMENTS

- A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

- 1. Structural loads.
- 2. Thermal movements.
- 3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
- 4. Dimensional tolerances of building frame and other adjacent construction.
- 5. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units to function properly.

- B. Structural Loads:

- 1. Wind Loads: shall be in accordance with CBC Section 1609A and ASCE 7-10, tested per ASTM E 330.
- 2. Seismic Loads: Seismic testing shall conform to AAMA recommended static test method for evaluating performance of curtain walls and storefront wall systems due to horizontal displacements associated with seismic movements and building sway.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity but not less than 10 seconds.

E. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft.

G. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

H. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.

I. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.69 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, isometrics, details, and attachments to other work.

1. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

- C. Samples for Verification: For each type of exposed finish required, on 1 inch long sections of extrusions or formed shapes and on 6 inch square sheets. Where normal color and texture variations are to be expected, include 2 or more units in each set of samples showing limits of such variations.
- D. Welding certificates.
- E. Qualification Data: For Installer and testing agency.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.
- G. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
 - 1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Accessible Entrances: Comply with CBC 2019.
- D. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY *(Project Close-Out Item)*

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, and other materials beyond normal weathering.
 - d. Water leakage through fixed glazing and framing areas.
 - e. Failure of operating components to function properly.
 2. Warranty Period: Three years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arcadia, Northrop Architectural Systems
 2. Howmet Aluminum Corp.
 3. PPG Industries, Inc.
 4. Vistawall Architectural Products.
 5. Alumiline/Aldora
- B. Basis-of-Design Product:
1. Aluminum-Framed Storefront
 - a. Arcadia, Inc., TC470 Series, 2-1/4 x 4-1/2" Thermally broken; captured offset glazed, 2 sided and 4 sided structural silicone, screw spline, shear block, compensating stick or punched opening fabrication for 1" Insulated glass
 - b. OR equal
 - c. Same manufacturer will provide Aluminum Framed storefronts, projected windows and Sun control devices.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308M.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.
- F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 8 Section "Glass and Glazing."

- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.
- D. Glazing Panels: Manufacturer's standard flush-laminated panels of thickness shown, fabricated with resin-impregnated Kraft paper honeycomb or rigid closed cell urethane core, laminated with waterproof glue between two sheets of aluminum.

2.5 DOORS

- A. Doors: Manufacturer's standard glazed doors, for manual swing operation.
 - 1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: As indicated.
 - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
 - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
 - 4. Provide glazed openings indoors as indicated, with manufacturer's standard aluminum mouldings and stops, with removable stops on the inside.
- B. Door Hardware: As specified in Division 8 Section "Door Hardware" other than that indicated herein to be provided by manufacturer of aluminum entrances.

2.6 DOOR HARDWARE

- A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.
 - 1. Opening-Force Requirements:
 - a. Egress Doors: Not more than 30 lbf required to set door in motion and not more than 15 lbf required to open door to minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf .
- B. Scheduled Door Hardware: Provide door hardware according to the Door Hardware Schedule at the end of Part 3.
 - 1. Named Manufacturer's Products: Product designation and hardware manufacturer are listed in the Door Hardware Schedule at the end of Part 3 to establish minimum requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware.

- a. Provide named hardware manufacturer's products.
 - b. Named products are basis-of-design products. Provide named hardware manufacturer's products or comparable products that are equivalent in function and quality and that are recommended and supplied by entrance system manufacturer.
 2. References to BHMA Standards: Provide products complying with standards referenced in this Article and with requirements for description, quality, type, and function listed in the Door Hardware Schedule at the end of Part 3.
- C. Pivot Hinges:
1. Standard: BHMA A156.4, Grade 1.
 2. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.
- D. Ball-Bearing Butts:
1. Standard: BHMA A156.1, Grade 1, radius corner.
 2. Provide nonremovable pins at hinges exposed to outside of door.
 3. Provide nonferrous hinges where hinges are exposed to weather.
 4. 5-knuckle, 2 bearing, sized to comply with ANSI A156.1, Grade 2 requirements.
 5. Quantities:
 - a. For doors with heights up to 87 inches, provide 3 hinges per leaf.
 - b. For doors with heights of greater than 87 and up to 120 inches, provide 4 hinges per leaf.
- E. Offset Pivot Sets: Assemblies complying with ANSI A156.4, Grade 1 requirements; with exposed parts of cast aluminum alloy; include intermediate pivot for doors over 87 inches high.
- F. Center Pivot Sets: Assemblies complying with ANSI A156.4, Grade 1 requirements; with exposed parts of cast aluminum alloy.
- G. Floor Concealed Closers: Units complying with ANSI A156.4, of the following types, grades, functions and features; include top pivots, cement cases, finished floor plates (unless thresholds indicated):
1. Type: Offset-hung, Grade 1.
 - a. Non-hold open.
 - b. Selective hold open.
 - c. Automatic hold open.
 - 1) Positive deadstop at opening angle selected by Architect.
 - d. Intermediate offset pivot.
 - e. Delayed-action closing
 2. Type: Center-hung, double acting; Grade 2 units.
 - a. Non-hold open.
 - b. Automatic hold-open of 90 or 105 degrees as selected by Architect.

3. Type: Center-hung, single acting; Grade 1 units.
 - a. Non-hold open.
 - b. Selective hold open.
 - c. Automatic hold-open of 90 or 105 degrees as selected by Architect.
 - 1) Positive deadstop at opening angle standard with manufacturer for hold-open angle selected by Architect.
 - d. Delayed-action closing.
- H. Overhead Closers: Units complying with ANSI A156.4, of the following type, grade, functions and features.
 1. Type: Concealed, single acting, Grade 2.
 - a. Independently hung, concealed arm and track.
 - b. Center pivoted, with bottom pivot.
 - c. Non-hold open.
 - d. Selective hold open.
 - e. Automatic hold open.
 2. Type: Concealed, double acting, Grade 2.
 - a. Non-hold open.
 - b. Automatic hold open.
 3. Type: Overhead, exposed, modern type with cover.
 - a. Grade 1
 - b. Grade 2
 - c. Hinge-side mounting.
 - d. Parallel arm mounting.
 - e. With hold-open arm
 - f. Delayed action closing.
- I. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles; fabricated to full height of door and frame.
- J. Balanced-Door Hinge Assembly: Manufacturer's standard mechanism with balancing guide roller and top- and bottom-sealed, self-aligning, antifriction bearings, arms, and pivots.
 1. Steel Hinge Tube:
 - a. Concealed in jamb.
 - b. Exposed.
 2. Clear-Opening Width: Reduction of clear-opening width by hinge assembly limited to 3 inches plus door thickness.
- K. Locking Devices, General: Do not require use of key, tool, or special knowledge for operation.
 1. Opening-Force Requirements:

- a. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf (67 N) for not more than 3 seconds.
 - b. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.
- L. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- M. Manual Flush Bolts: BHMA A156.16, Grade 1.
- N. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
- O. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- 1. Standard: BHMA A156.3, Grade 1.
- P. Cylinders:
- 1. Inside units, 5 pin tumbler, with cast aluminum face.
 - 2. Outside units, 5 pin tumbler, with cast aluminum face.
- Q. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE"
- R. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- S. Operating Trim: BHMA A156.6.
- T. Removable Mullions:
- 1. Standard: BHMA A156.3.
 - 2. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.
- U. Closers: With accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use, and adjustable to meet field conditions and requirements for opening force.
- 1. Standard: BHMA A156.4, Grade 1.
- V. Concealed Overhead Holders: BHMA A156.8, Grade 1.
- W. Surface-Mounted Holders: BHMA A156.16, Grade 1.
- X. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- Y. Weather Stripping: Manufacturer's standard replaceable components.
- 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- Z. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- AA. Silencers: BHMA A156.16, Grade 1.
- BB. Thresholds: Extruded aluminum, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch. Complete with anchors and clips, coordinated with pivots and floor-concealed closers, of size indicated or manufacturer's standard if not indicated.
1. Standard: BHMA A156.21.
- CC. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.
- DD. Flushbolts: Standard edge mortised type, for inactive leaves of pairs of doors.
1. Provide at top of doors only.
 2. Provide both top and bottom of doors.
- EE. Automatic Flushbolts: Edge mortised type at top and bottom of inactive leaf of pair of doors; used in combination with single point, center mounted deadlock in active leaf; with concealed rod mechanism in lock stile of inactive leaf; with two-stage locking of both leaves and one stage unlocking of both leaves by actuation of deadlock.
- FF. Lever Handles: Inside units of cast aluminum alloy.
- GG. Thumb-Turns: Inside cylinders of cast aluminum alloy.
- HH. Deadlatches: Standard mortise type with stainless steel strike box.
- II. Deadlocks: Mortise maximum security type, with 1 inch minimum length pivoted bolt, stainless steel strike box.
- JJ. Panic Hardware:
1. Concealed-rod devices complying with UL 305 and actuated by full-width crash bar.
 - a. At Contractors option, provide concealed rod device complying with UL 305 with latch releasing mechanism recessed into crossrail of doors and actuated by push panel.
 2. Exposed rod devices complying with UL305 and actuated by full width crash bar.
 3. Rim type center latch bolt complying with UL 305 and actuated by full width crash bar.
- KK. Push-Pull Plates: Standard aluminum units of style indicated, or as recommended by manufacturer if not indicated.
- LL. Push Bars: Standard aluminum units of style indicated, or single bar full door width of type recommended by manufacturer if not indicated.

- MM. Pull Handles: Standard aluminum of style indicated, or as recommended by manufacturer if not indicated.

2.7 ACCESSORY MATERIALS

- A. Insulating Materials: As specified in Division 7 Section "Building Insulation."
- B. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."
- C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.8 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from exterior and interior for vision glass and exterior for spandrel glazing or panels.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).
- E. Storefront Framing: Fabricate components for assembly using shear-block system.
- F. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
 - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- G. Doors: Reinforce doors as required for installing hardware.

1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

- H. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
1. Comply with manufacturer's written instructions.
 2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 6. Seal joints watertight, unless otherwise indicated.
- B. Metal Protection:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.
 - E. Install components plumb and true in alignment with established lines and grades, without warp or rack.
 - F. Install glazing as specified in Division 8 Section "Glazing."
 - G. Entrances: Install to produce smooth operation and tight fit at contact points.
 - 1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
 - 2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
 - H. Install insulation materials as specified in Division 7 Section "Building Insulation."
 - I. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.
 - J. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
 - 3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.
- 3.3 FIELD QUALITY CONTROL
- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
 - C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 3.4 ADJUSTING
- A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.

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1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

END OF SECTION 08 41 13

(sfa-4/21)

SECTION 09 24 00 - PORTLAND CEMENT PLASTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Nonstructural steel framing and furring.
 - 2. Exterior portland cement plasterwork (stucco) on metal lath plaster bases.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of factory-prepared finish coat indicated.
- C. Samples for Verification: For each type of colored and textured finish coat indicated; 12 by 12 inches, and prepared on rigid backing.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For portland cement plaster assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Mockups: Before plastering, prepare mockups of at least 4 feet by 4 feet area by full thickness to demonstrate final aesthetic effects and set quality standards for materials and execution.
 - 1. Install mockups for each type of finish indicated and with materials, including lath and support systems, indicated for final work.
 - 2. For interior plasterwork, simulate finished lighting conditions for review of mockups.
 - 3. Obtain Architect's acceptance of panel's visual quality before commencement of work.
 - 4. Retain panel(s) during construction as a standard for judging completed work.
 - 5. Remove panel(s) at completion and acceptance of work.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
- D. Standards: Plastering shall be done in accordance with these specifications; the "Reference Specifications" of the California Lathing and Plastering Contractor's Association,

Inc. (latest edition); The Metal Lath manufacturer's Association specifications, and Title 24, 2019 CBC, Chapter 25.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 PROJECT CONDITIONS

- A. Comply with ASTM C 926 requirements.
- B. Exterior Plasterwork:
 - 1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
 - 2. Apply plaster when ambient temperature is greater than 40 deg F.
 - 3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
- C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 NONSTRUCTURAL STEEL FRAMING MEMBERS, GENERAL

- A. Manufacturers:
 - 1. Chicago Metallic Corporation
 - 2. Gold Bond Building Products Div., National Gypsum Co.
 - 3. Milcor Division; Inryco, Inc.
 - 4. United States Gypsum Co.
 - 5. Western Metal Lath & Steel Framing Systems.

- B. Components, General: Comply with ASTM C 1063. For steel sheet components not included in ASTM C 1063, comply with ASTM C 645 requirements for metal, unless otherwise indicated.
- C. Cold-Rolled Channels: Base metal thickness of 0.0538 inch with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
- D. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter, unless otherwise indicated.

2.3 METAL LATH

- A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
 - 1. Manufacturers:
 - a. California Expanded Metal Products Company (CEMCO).
 - b. Gold Bond Building Products Div., National Gypsum Co.
 - c. Milcor Division; Inryco, Inc.
 - d. United States Gypsum Co..
 - e. Western Metal Lath & Steel Framing Systems.
 - 2. Diamond-Mesh Lath: Self-furring.
 - a. Weight: 3.4 lb/sq. yd.
 - 3. 3/8-Inch Rib Lath:
 - a. Weight: 3.4 lb/sq. yd.
- B. Wire-Fabric Lath:
 - 1. Manufacturers:
 - a. Davis Wire Corporation.
 - b. Jaenson Wire Company.
 - c. Keystone Steel & Wire.
 - 2. Woven-Wire Lath: ASTM C 1032; self-furring, with stiffener wire backing.
 - a. 17 gage. x 1-1/2 inch galvanized.
- C. Paper Backing: FS UU-B-790, Type I Grade D, Style 2 vapor-permeable paper. Two layers, 30 minute and in accordance with 2010 CBC Section 2510.6.

2.4 ACCESSORIES

- A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Zinc and Zinc-Coated (Galvanized) Accessories:

1. Manufacturers:
 - a. California Expanded Metal Products Company (CEMCO).
 - b. Fry Regelet Corporation
 - c. Gold Bond Building Products Div., National Gypsum Co.
 - d. Keene Corporation
 - e. Milcor Division; Inryco, inc.
 - f. United States Gypsum Co.
 - g. Western Metal Lath & Steel Framing Systems.
2. Foundation Weep Scream: Western No. 7 or No. 36. Fabricated from hot-dip galvanized steel sheet, ASTM A 653/A 653M, G60 zinc coating.
3. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
4. External-Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
5. Cornerbeads: Western No. 1A. Fabricated from zinc or zinc-coated (galvanized) steel.
 - a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
 - b. Small nose cornerbead with perforated flanges; use on curved corners.
 - c. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing masonry corners.
 - d. Allow full encasement of plaster.
6. Casing Beads: Western No. 66. Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
7. Control Joints: Keene XJ15-3. Fabricated from zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
8. Expansion Joints: Fabricated from zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
9. Two-Piece Expansion Joints: Western No. 40. Fabricated from zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4-to-5/8-inch wide; with perforated flanges.
10. Soffit vent screeds: As indicated

2.5 MISCELLANEOUS MATERIALS

- A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in portland cement plaster.
 1. Products:
 - a. Dur-O-Fiber AR Glass; Dur-O-Wall
 - b. Harbourite; Fibermesh, Inc.
- C. Bonding Compound: ASTM C 932.
- D. Steel Drill Screws: Galvanized, for metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with wafer head that is suitable for

application; in lengths required to achieve penetration through joined materials of not fewer than ¼ inch.

- E. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.
 - 1. Nails: Galvanized furring nails, No. 12 gauge 3/8 inch head with 3/8 inch wad spacers for lath attachment. Minimum 1-1/4 inch penetration into structure.
 - 2. Ring Shank Hook Staples: No. 9 W & M gauge, ½ inch wide x 1-1/2" inches long "J" staple for soffit application only.
 - 3. Earthquake Staples: No. 16 gauge, galvanized, round or flattened wire, with chisel or divergent points, ¾ inch crown and 1-1/4 inch legs for soffit application only.
 - F. Wire Ties: 16 gage galvanized.
 - G. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing), produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - H. Isolation Strip at Exterior Walls:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), unperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.
 - I. Window and/or Door Flashing, provide either of the following:
 - 1. Kraft paper flashing conforming to F.S. UU-B-790A, Style 4, Grade A,B,C; 6 inch minimum width in the vertical wall plane.
 - 2. Self-adhered rubberize asphaltic membrane i.e. Vicor by Grace Manufacturing, 6 inch minimum width in the vertical wall plane.
- 2.6 PLASTER MATERIALS Retain second option in first paragraph below if sulfate resistance is required.
- A. Portland Cement: ASTM C 150, Type I or III.
 - 1. Color for Base Coats: Gray.
 - B. Masonry Cement: ASTM C 91, Type N.
 - 1. Color for Base Coats: Gray.
 - C. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
 - D. Sand Aggregate: ASTM C 897.
 - 1. Color for Job-Mixed Finish Coats: In color matching Architect's sample.
 - E. Ready-Mixed Integral Color Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Products:
 - a. LaHabra Stucco.
 - b. King Stucco Inc.
 - c. Superior Stucco Products
 - d. Western Stucco Products Inc.
2. Color: As selected by Architect from manufacturer's full range.

F. Additives: "PRF", Gibco Industries.

2.7 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 2 lb of fiber/cu. ft. of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

- a. Scratch Coat (3/8"): For cementitious material, mix 1 part portland cement, 3 oz. PRF (per 94 lbs Portland cement). Use 4 parts sand per part of cementitious material (sum of separate volumes of each component material).
- b. Brown Coat (3/8"): For cementitious material, mix 1 part portland cement, 3 oz. PRF (per 94 lbs. Portland cement). Use 5 parts sand per part of cementitious material (sum of separate volumes of each component material).

C. Factory-Prepared Finish-Coat Mixes (1/8"): For ready-mixed finish-coat plasters, comply with manufacturer's written instructions. Add water only.

1. Finish coat shall be textured as noted on the Drawings or as selected by Architect.

D. Mixing: Mechanically mix cementitious and aggregate material for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

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

3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare solid-plaster bases that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.3 INSTALLATION, GENERAL

- A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
- B. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.
- C. Acoustical Sealant: Where required and indicated, seal joints between edges of plasterwork and abutting construction with acoustical sealant.
- D. Sealant: Seal around all window frames and transition to provide a “water tight” exterior finish.

3.4 INSTALLING NONSTRUCTURAL STEEL FRAMING, GENERAL

- A. General: Comply with requirements in ASTM C 1063 for applications indicated.
 - 1. Comply with ASTM C 754 for installation of items not addressed in ASTM C 1063.
- B. Install supplementary framing, blocking, and bracing at terminations in plaster assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement.
 - 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
 - 2. Isolate partition framing and wall furring where it abuts structure, except at floor. At head of assemblies, install slip-type joints that avoid axial loading and that support assembly laterally.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.
- E. Soffits: Unless otherwise detailed on Drawings, install furred or suspended soffits to comply with requirements for ceiling installation; install framed soffits to comply with requirements for partition installation.

3.5 INSTALLING METAL LATH

- A. General: Install expanded metal lath or stucco netting where plaster base is required. Provide appropriate type, configuration and weight of material selected from materials indicated which comply with referenced lathing installation standards.
 - 1. Comply with the requirements of ML/SFA "Specification for METAL Lathing and Furring" applicable to each installation condition indicated.
- B. Ceramic Tile Setting Beds:
 - 1. Use diamond mesh lath, 3.4 lbs. per square yard, paper backed. Maximum variation in the backing surface shall not exceed 1/8" in 8 feet from the required plane.
- C. Exterior Sheathed Wall Surfaces; Steel Stud Construction: Install 2 layers 60 minute, Grade D paper, shingle style over sheathing with 3 inch edge laps and 6 inch end laps. Over building paper install self furring stucco netting. Provide wadding for sheet metal screw attachment to maintain ¼ inch minimum spacing of netting from backing surface. Self furring stucco netting shall be installed to maintain ¼ inch spacing of netting from backing surface in all conditions.

3.6 INSTALLING ACCESSORIES

- A. Install according to ASTM C 1063 and at locations indicated on Drawings.
- B. Reinforcement for External Corners:
 - 1. Install lath-type external-corner reinforcement at exterior locations.
 - 2. Install cornerbead at interior locations.
- C. Control Joints: Install control joints at locations indicated on Drawings, or if not indicated in specific locations complying with following criteria and approved by Architect for visual effect as follows:
 - 1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 sq. ft..
 - b. Horizontal and other Nonvertical Surfaces: 100 sq. ft..
 - 2. At distances between control joints of not greater than 18 feet o.c.
 - 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1. 10 feet maximum in both vertical and horizontal dimensions.
 - 4. Where control joints occur in surface of construction directly behind plaster.
 - 5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.
 - 6. Attach control joints to stucco mesh by wire tying at 24 inches on center.
- D. Drip Screeds: Install drip screed a minimum of 4 inches above grade, unless otherwise shown.

- E. Soffit Vent Screeds: Install soffit vent screed where shown sufficient to vent all concealed attics, joist spaces, etc.
- F. Window Flashing: Install window flashing material at window head, jambs and sill. Lap adjacent flashing material 6 inches minimum.

3.7 PLASTER APPLICATION

- A. General: Comply with ASTM C 926.
 - 1. Do not deviate more than plus or minus 1/8 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed on surface.
 - 2. Grout hollow-metal frames, bases, and similar work occurring in plastered areas, with base-coat plaster material, before lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout at least 6 inches at each jamb anchor.
 - 3. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground, unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
 - 4. Provide plaster surfaces that are ready to receive field-applied finishes indicated.
- B. Curing: Moisture cure Portland cement plaster base and finish coats to comply with ASTM C 926, including between coats and curing required by 2007 CBC, Table 2512.6.
- C. Bonding Compound: Apply on unit masonry and concrete plaster bases.
- D. Plaster Finish Coats: Apply to provide finish and texture to match Architect's sample.
- E. Sand smooth-troweled finishes lightly to remove trowel marks and arises.
- F. Apply fog coat over patches and adjacent areas where there is a transition in surface plane.
- H. Caulk or seal around all window frames and transitions to provide a "water tight" ext. finish.

3.8 CUTTING AND PATCHING

- A. Cut, patch, replace, and repair plaster as necessary to accommodate other work and to restore cracks, dents, and imperfections. Repair or replace work to eliminate blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.9 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of other work. Promptly remove plaster from doorframes, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 09 24 00

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SECTION 12 35 50 – SCIENCE CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following casework and countertops as indicated on the drawings:
 - 1. Science Cabinets. (PS)
 - 2. Chemical Resistant Solid Panel.

1.3 DEFINITIONS

- A. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, visible surfaces in open cabinets, behind glass doors, and edges visible when doors and drawers are closed. Surfaces visible from upper floors and/or stairways will be considered exposed.
- B. Semi-exposed Surfaces of Casework: Surfaces behind opaque doors and drawer fronts, including interior faces of doors and interiors and all sides and bottoms of drawers, interior of cabinet ends, backs and tops and bottoms, shelves and dividers. Bottoms of wall cabinets 2'-0" above floor and tops 2'-0" or more above floor are defined as "semi-exposed."
- C. Concealed Surfaces of Casework: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends of cabinets installed directly against and completely concealed by walls or other cabinets are defined as "concealed."

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's standard specifications for the following:
 - 1. Cabinets.
 - 2. Plastic-laminate/Solid Surface countertops.
 - 3. Chemical Resistant Solid Panel.
 - 4. Cabinet hardware.
- B. Shop Drawings: For cabinets and countertops. Show locations and sizes of each type of cabinet and counter top. Include fully dimensioned plans, elevations, details, and all attachments to other work. Show materials, finishes, filler panels, hardware, edge and backsplash profiles, cutouts for plumbing fixtures, and methods of joining countertops.
- C. *Fabricator's License: Provide current fabricator's Certified Compliance License that warrants the manufacturer has been licensed by the Woodwork Institute and has met the requirements to manufacturer casework in compliance with the Woodwork Institute Manual*

*of Millwork; grade of casework specified herein. **Fabricator's not having current License stated, will be rejected.***

- D. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material exposed to view.
- E. Samples for Verification: For the following materials; in sets showing the full range of color, texture, and pattern variations expected:
 - 1. Plastic laminate for casework finish, 8 by 10 inches.
 - 2. Plastic laminate for countertops, 8 by 10 inches.
 - 3. Chemical Resistant Solid Panel, 6 inches square.
 - 4. One unit of each type of exposed hardware.
 - 5. Solid Surface Countertops, 2 by 2 inches.
- F. Product Certificates: Woodwork Institute Certificates. Certificates shall warrant that the cabinets meet all requirements of for Woodwork Institute "Custom Grade". Submit certificates at project close out.

(Project Close-out Item)

1.5 QUALITY ASSURANCE

- A. Source Limitations for Cabinets: Obtain cabinets through one source from a single manufacturer.
- B. Quality Standards: Unless otherwise indicated, comply with the following standards:
 - 1. Cabinets: Woodwork Institute "Custom Grade"
 - a. Provide Woodwork Institute Certification: Each cabinet shall be Woodwork Institute Certified, bearing the "stamp of certification" affixed in a semi-exposed location on each unit and showing compliance with the above standard, *when in the sole opinion of the Architect, the quality of the product provided is in question or does not meet the quality standards of the Woodwork Institute's Manual of Millwork. This certification shall be provided on all casework in question at no additional cost to the owner.*
 - b. Contractor shall disregard W.I. 2003, Section 15, Part 1, 1.2.5.
 - c. All case work shall comply with the 2019 CBC, Section 11B-226.
 - 2. Chemical Resistant Solid Panel Countertops: Countertops shall be fabricated by a manufacturer's certified fabricator.
- C. Cabinet Design Requirements:
 - 1. Woodwork Institute cabinet design series (CDS):
 - a. Cabinet design requirements are designated on drawings using Woodwork Institute "Cabinet Design Series (CDS)" numbering system.
 - b. Where individual cabinet design requirements do not fit within the CDS numbering system, cabinet design requirements are detailed on drawings.

2. Catalog Standards:

- a. Manufacturer's catalog numbers may be shown on drawings for convenience in identifying certain cabinet design requirements. Unless modified by notation on drawings or otherwise specified, catalog description for indicated number constitutes requirements for each such cabinet.
- b. The use of catalog numbers is not intended to preclude the use of any other acceptable manufacturer's products, which are equivalent, but are given for the purpose of establishing design requirements.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Protection and Storage: Protect cabinets and countertops during transit, delivery, storage and handling to prevent damage, soiling and deterioration. Store cabinets and counter tops in installation areas or, if not practical, in areas with ambient conditions meeting same requirements.
- C. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.
- D. Field Measurements - Retrofit: Where casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes if necessary.
- E. Field Measurements for Countertops: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 COORDINATION

- A. Coordinate layout and installation of all blocking and reinforcement in partitions for support of casework.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Plastic Laminates:
 - a. Nevamar Corp. – with "Armor Protection Plus"

- b. Wilsonart: Ralph Wilson Plastics Co. – with “High Wear Laminate”
- 2. Chemical Resistant Solid Panel:
 - a. Trespa, North America, (415) 541-0969
 - b. Resistop
- 3. Cabinet Locks:
 - a. Olympus
- 4. Coat Hooks:
 - a. Raymond Engineering Company, (800) 365-5770
- 5. Flammable and Chemical Storage Cabinets:
 - a. Justrite Manufacturing.
- 6. Drawer Guides:
 - a. Accuride International, or approved equal.

2.2 COLORS, TEXTURES, AND PATTERNS

- A. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range for these characteristics.

2.3 CABINET MATERIALS

- A. Exposed Materials: Comply with the following:
 - 1. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3, Grade VGS. Vertical surfaces - .028 to .030 inches thick. Horizontal surfaces - .062 inches thick. With coved splashes use .050 Postforming Grade.
 - 2. Chemical Resistant Plastic Laminate: Chemical resistant with high wear coating.
 - 3. PVC Edge Molding: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, and 1 mm thick elsewhere.
- B. Semiexposed Materials: Unless otherwise indicated, provide the following:
 - 1. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
 - 2. Thermoset Decorative Panels: Medium-density particleboard complying with ANSI A208.1, Grade M-2; with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

- a. Provide thermoset decorative overlay on both sides of shelves, dividers, drawer bodies, and other components with two semiexposed surfaces.
- b. Provide PVC edge banding complying with LMA EDG-1 on components with semiexposed edges.

C. Concealed Materials: Comply with the following:

1. Solid Wood or Plywood: Any hardwood or softwood species, with no defects affecting strength or utility. Hardwood and softwood lumber kiln dried to 7 and 10 percent moisture content, respectively.
2. Particleboard: ANSI A208.1, Grade M-2. Density – 45 lbs. cu. ft.
3. Medium-Density Fiberboard: ANSI A208.2.
4. Hardboard: AHA A135.4, Class 1 Tempered.

2.4 COUNTERTOP MATERIALS

- A. Chemically Resistant Solid Panel: Trespa Toplab, ¾ inch thick, or Resistop ¾" thick

2.5 CASEWORK HARDWARE

- A. General: Color as selected by architect.
- B. Door Hinges: Wrap around type 2-3/4" x 3-5/8". .078 steel with 4 screws each into door, five screws into end panel. Hospital tip, rounded corner knuckles and fixed pins.
- C. Sliding Doors: Steel with nylon roller carriers, suspended type.
- D. Magnetic Catches: HD Type. On tall cabinet doors.
- E. Catches: Integral type on hinged doors.
- F. Drawer Guides:
- a. File Drawers: 3 piece full extension side guides rated at 100 lbs. With positive stops to prevent inadvertent removal.
 - b. Paper Storage Drawers or Drawers over 36" wide: 2 piece roller side guides rated at 150 lbs. With positive stops to prevent inadvertent removal.
 - c. Standard Drawers: Full extension rated at 100 lbs. With positive stops to prevent inadvertent removal.
- G. Drawer Bumper Stops: Adjustable at each side rear to prevent impact on drawer front.
- H. Pulls:
1. All Areas: 4" U shaped handles for drawers and hinged doors; sliding doors -- Finish as selected by Architect from US32, US32D US28 or from manufacturer's full list of available colors.
- I. Adjustable Shelf Clips: Steel with pins for ¼ inch drilled holes with earth quake pins to hold shelves against lateral movement, Hettich America, Sekura # 6, or approved equal.
- J. Locks:

1. Multiple cabinet locks in room keyed alike. (Each room to be keyed different). Master key that will open all casework locks on site. 5 pin tumbler. Model #500DR (for doors). Model #600DW (for drawers).

K. Glass for Glazed Doors: ¼ inch tempered, clear.

L. Coat Hooks: REI #923, Color to be selected by architect from Black, Bronze, Gold, Clear Anodized.

M. Cantilever Countertop Supports: Provide cantilever countertop supports as manufactured by A & M Hardware Inc, Manheim PA, 888.687.0200. Supports shall have a minimum of 1000 lb load limit. Provide appropriate size support for size of countertop shown on contract drawings. Support shall have notch for wire run clearance. Color to be chosen by Architect from manufacturer's standard colors, black, white, grey or almond.

2.6 CABINET CONSTRUCTION (PC)

A. General: All cabinets factory assembled. All exposed vertical and horizontal surfaces shall be finished with high pressure laminated plastic unless otherwise indicated. Materials not shown or specified, best quality manufacture's standard or as otherwise approved. All parts precision machined to close tolerances, accurately fitted and assembled with appropriate fastenings and adhesives required to produce first quality fixtures, square, true, level and plumb.

B. End Panels and Partitions: ¾ inch thick particleboard with plastic-laminate faces and backs, edges faced with laminated plastic. Provide same grade, pattern, color, and texture of plastic laminate for backs as for faces. Backing sheet on interior or enclosed surfaces. End panels grooved to receive case backs, all parts lock-jointed.

C. Doors: ¾ inch thick particleboard, front surfaced with laminated plastic and edged with 3mm PVC edging, backs surfaced with interior or backing sheet. Overlaid type doors. Where full height doors open.

D. Cabinet Backs: Groove all members to receive ¼" prefinished hardboard on unexposed backs where required or scheduled. Exposed backs and backs on movable cabinets, ½" overlaid plywood or particle board surfaced with laminated plastic. Interior face surfaced with backing sheet.

E. Drawers:

1. Overlaid type fronts, ¾" particle board surfaces with laminated plastic and 3mm PVC edging, backing sheet on inside face; sides and back ½" overlaid particle board, lock-jointed or dovetailed into front and tenoned sides to back; smoothly sanded and coated with varnish drawer sealer.
2. Bottoms: ¼" thick prefinished hardboard. To match interior, housed into front, sides and back, glued and stapled.

F. Shelves: All shelving shall be particle board surfaces with overlay. All shelving shall be adjustable at 1" vertical intervals unless noted otherwise. All shelves drilled both ends for shelf clip retainer pins. All shelves shall be 1" thick. Shelves longer than 36" shall have intermediate supports at 36" maximum spacing. Exposed shelves shall be edge-banded with 3mm PVC edging and plastic laminate finish on horizontal surface.

- G. Filler and Service Access Panels: Provide filler and service access panels to conceal all utility piping, conduits and devices with finish to match adjacent surfaces. Provide removable panels secured with screws and grommets at valves, clean outs, devices and connectors that may require adjustment and service.
- H. Framing: Complete skeleton frames and head rails of overlaid plywood, securely glue and dowel or other approved method, required under all countertop base cabinets.
- I. Bases: Base material shall be from solid wood stock. Continuous bases leveled and squared before units are installed, cabinets leveled and anchored to base.

2.7 SCIENCE CABINETS (PS)

- A. Trespa Toplab Countertops, 3/4" thick, color as selected by the Architect from manufacturer's standard colors. As manufactured by Trespa, North America Ltd. (415) 541-0969.

Or

Resitop Countertops, 3/4" thick, color as selected by Architect from manufacturer's standard colors as manufactured by HTC, Inc. and distributed by Western Specialty Products 408.363.2360.

Sinks integral to science countertops shall be Prime-Resin P-15C or equal, to match countertop, 16" x 12" x 8" deep inside (at D.A. Station 6-1/2" maximum depth), epoxy resin with PSA sink supports.

- B. Refer to Cabinet Construction (PC) for all other cabinetry requirements.

2.8 FLAMMABLE AND CHEMICAL STORAGE CABINETS

- A. Undercounter Flammable Storage Cabinets: Shall be 2 door self closing, 22 gallon capacity, U.L. or Factory Mutual, and California State Fire Marshall approved. Model No. 25732
- B. Chemical Storage Cabinets: Shall be 2 door self closing, 22 gallon capacity, , U.L. or Factory Mutual, and California State Fire Marshall approved. Color: Blue with White/Black lettering, Model No. 25702.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install casework as specified in the Woodwork Institute Manual of Millwork, section 26 and provide a Woodwork Institute Certified Compliance Certificate for installation at the completion of project. *(Project Closeout Item)*
- B. Install casework with no variations in flushness of adjoining surfaces; use concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match casework face.

- C. Install casework without distortion so doors and drawers fit openings and are aligned. Complete installation of hardware and accessories as indicated.
- D. Install casework and countertop level and plumb to a tolerance of 1/8 inch in 8 feet.
- E. Fasten cabinets to adjacent units and to backing as indicated on the drawings to conform to DSA requirements
- F. Fasten plastic-laminate countertops by screwing through corner blocks of base units into underside of countertop. Form seams using splines to align adjacent surfaces, and secure with glue and concealed clamping devices designed for this purpose.
- G. Fasten solid-surfacing-material countertops by screwing through corner blocks of base units into underside of countertop. Align adjacent surfaces, and form seams to comply with manufacturer's written instructions using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- H. All wall coverings referenced in Division 9 shall be installed prior to installation of this work. Coordination of such with other trade shall be required.

3.2 ADJUSTING, CLEANING AND PROTECTION

- A. Adjust casework and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- B. Clean casework on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Installer shall advise Contractor of final protection and maintained conditions necessary to ensure that work will be without damage or deterioration time of acceptance.
- D. Cover completed work with 4 mil polyethylene protective enclosure, applied in a manner to allow easy removal without damaging cabinets or adjoining work. Remove cover immediately before time of final acceptance.

3.2 PROJECT CLOSE-OUT

- A. See individual headings in this section for exact requirements.

END OF SECTION 12 35 50

(04-21)

SECTION 13 34 23.13 - MODULAR BUILDINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specifications sections apply to work specified in this section.
- B. Related Sections:
 - 1. General Mechanical/Plumbing /Fire Protection System Requirements.
 - 2. Division 26 “Electrical”.
 - 3. Division 27 “Communications”
 - 4. Division 28 “Electrical Safety and Security”

1.02 DESCRIPTION OF WORK:

- A. Extent of Modular Buildings work is shown on drawings.
- B. Type is clear span rigid frame building modules of nominal width, length, ceiling height and module size indicated and/or specified. Structure may be wood or steel.
- C. Manufacturer's standard components may be used, providing components, accessories, and complete structure conform to architectural design appearance shown and to specified requirements.
- D. Buildings shall be new buildings and foundation shall be concrete.
- E. As defined in Title 24 of the California Administrative Code, “The Architect is responsible to the School Board for the safety of the structure, as well as the utility, economy, durability and aesthetics of the work contemplated by his plans and specifications.”
- F. The building shall consist of a steel or wood frame structure, which is engineered by the manufacturing company. The General Contractor shall provide drawings and calculations acceptable to the Architect, meeting the provisions of California Administrative Code. The General Contractor shall bear all costs for production of drawings and associated structural calculations. Contractor shall make all revisions and corrections to those documents required by Division of State Architect and resubmit as required to obtain approval.
- G. The Architect's decision about the product aesthetics shall be binding on the General Contractor and the product manufacturer.

1.03 QUALITY ASSURANCE:

- A. Design Criteria:
 - 1) For structural steel members, comply with AISC “Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings”.
 - 2) For light gage steel members, comply with AISI “Specification for the Design of Cold-Formed Steel Structural Members” and Section 2701 (a) 2 Title 24, C.C.R.
 - 3) For welded connections, comply with AWS “Structural Welding Code”, Welding Inspection shall comply with the requirements of Section T24-27.923.

B. For Wood Framing:

- 1) Lumber Standards: Comply with PS20 and with applicable rules of the respective grading and inspection agencies for species and products indicated.
- 2) Plywood Product Standards: Comply with PS1 (ANS1 A199.1) or, for products not manufactured under PS1 provisions, with applicable APA performance standard for type of panel indicated.
- 3) Design Loads: Basic design loads, as well as auxiliary and collateral loads are as follows:
- 4) Wind Load: In accordance with Section 2311, Title 24.
- 5) Roof Live Load: 20 PSF
- 6) Floor Live Load: 50 PSF
- 7) Design each member to withstand stresses resulting from combinations of loads that produce maximum percentage of actual to allowable stress in that member.

C. Fabrication Criteria: Provide Modular buildings as produced by a manufacturer who is regularly engaged in fabrication and erection of Modular structures of type and quality indicated.

- 1) Design prefabricated components (Modules) and necessary field connections required for erection to permit easy assembly and disassembly. Fabricate components (Modules) in such manner that once assembled they may be disassembled, moved, and reassembled with a minimum amount of labor and maximum salvageability.

1.04 MANUFACTURER:

A. Provide building(s) by one of the following Manufacturers:

- 1) Enviroplex Inc., Stockton, CA
- 2) AMS, Manteca, CA
- 3) Silver Creek ,Perris, CA
- 4) JL Modular, Santa Rosa, CA
- 5) Meehleis Modular, Lodi, CA

- B. Manufacturers not on the above list may request a substitution approval prior to bidding, in accordance with Division 1. Failure to comply with this process will automatically disqualify a bidder.

1.05 SUBMITTALS:

- A. Manufacturer's drawings, standard details and specifications for building assemblies manufactured hereunder shall be submitted to the Architect for review and his submission to governing authorities in compliance with governing codes, rules and regulations, and stamped approval obtained thereon as prescribed by Codes. Modular Building must meet State of California, Department of General Services, Division of the State Architect construction requirements.
- B. Design and structural calculations shall be prepared by a structural engineer registered by the State of California, or as otherwise required by governing State Authorities and submitted to the Architect for review and his submission to the governing authorities for approval.
- C. Additional drawings and instructions deemed necessary to carry out the work included in Contract shall be supplied to, or by, the manufacturer and so prepared as to be consistent with the Contract Documents. Drawings and Design of for Electrical, Mechanical and Plumbing

and Fire Protection Systems shall also be signed by a licensed professional for each particular discipline and shall be submitted with proper calculations for review and approval to the governing authorities.

1.06 GOVERNING CODES:

- A. All work and materials to comply with the latest rules and regulations of the Division of the State Architect, Title 19, 21 & 24, California Administrative Code, the regulations of the State Fire Marshal; the Safety Orders of the Division of Industrial Safety; the National Electric Code; the Uniform Building Code; the Uniform Plumbing Code; published by the Western Plumbing Officials Association; and any other applicable state laws and regulations.
- B. Energy Requirements: Buildings manufactured must comply with the State Energy Conservations Standards, Title 24, for new non-residential buildings. Manufacturers must certify that their buildings meet the energy requirements and if any government agency requires, manufacturers must supply documentary evidence of such compliance.

1.07 VENTILATION UNDER BUILDING

- A. Provide for the free flow of air under the supported floor of the building. Provide vents equivalent to one and one-half (1-1/2) square feet of vent per 25 lineal feet for exterior walls. If through foundation skirting, vents shall be heavy gauge galvanized expanded metal. Vents in horizontal surfaces (walks, decks) to be "Polyvent" 10, 12 Series with vandal resistant bar grate with 1/2" spacing.

1.08 ACCESS UNDER BUILDING

- A. Provide 2'x4' access vent well with retained metal grate.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. STRUCTURAL & MISCELLANEOUS METALS:

- 1) Steel: (Structural Shapes) ASTM A36
- 2) Sheet Steel: - ASTM A-570 (Grade C)
- 3) Steel Tubes: - ASTM A-500, Grade B
- 4) Castings: ASTM A-27-62, Class 70-40
- 5) Bolts: ASTM A307 or A325

2.02 SHEET METAL ACCESSORIES:

- A. General: Unless otherwise indicated, provide minimum 24 Ga. galv. sheet, Redi-Cote or equal.
- B. Gutters: Formed in sections not less than 8 ft. in length, complete with end pieces, outlet tubes, and special pieces that may be required. Join sections with riveted and soldered joints. Unless otherwise indicated, provide expansion-type slip joint at center of runs. Furnish gutter supports spaced at 36" o.c., constructed of same metal as gutters. Provide standard bronze, copper, or aluminum wire ball strainers at each outlet. Gutters shall be easily cleaned.
- C. Downspouts: Formed in sections approximately 10 ft. long, complete with elbows and offsets. Join sections with minimum 1-1/2" telescoping joints. Downspouts to be 3" x 4" typical. Provide fasteners for top, bottom, and 5' o.c. intermediately between, designed to securely

hold downspouts not less than 1” away from walls. Downspouts to be spaced as required, and spill to grade (through pipe at front of classroom).

2.03 SIDING AND CEMENT PLASTER SYSTEMS

- A. Fiber-Reinforced Cementitious Panels, per specification section 07 46 00.
- B. Three part cement plaster system, per specification section 09 24 00.

2.04 ROOFING

- A. Built-up Roof: Roofing will be 4-ply built-up roof “Fiberglas 43 NC” or approved equal. Class rating as per U.B.C., Table 32(A).
- B. Metal Standing Seam Roofing, per specification section 07 41 00.
- C. All roofing shall be guaranteed watertight for a period of 2 years following substantial completion.

2.05 THERMAL INSULATION

- A. Insulation: Regardless of calculations or code requirements, provide R-19 (wall and floor) and R-30 (ceiling) glass fiber blanket (minimum) with U.L. flamespread classification of 25 or less, where exposed. Provide more insulation where required by energy calculations.
 - a. Vapor barrier, foil reinforced kraft, or kraft faces.

2.06 HOLLOW METAL DOORS & FRAMES

- B. Standards: Comply with requirements of Steel Door Institute “Recommended Specifications for Standard Steel Doors and Frames” (SDI-100), and as herein specified.
- C. Materials: Steel doors and frames; hot-rolled, pickled and oiled per ASTM A 569 and A 568; cold-rolled per ASTM A 366 and A 568.
- D. Galvanized sheets, ASTM A 526 with ASTM A 525, G60 zinc coating, mill phosphatized.
- E. Anchors and Accessories: Manufacturer’s standard units. Use galvanizing items for units built into exterior walls, complying with ASTM A 153.
- F. Fabrication: Fabricate units to be rigid, neat in appearance, and free from defects, warps or buckle. Weld exposed joints continuously, grind, dress, and make smooth, flush and invisible.
 - 1) Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling and tapping, complying with ANSI A 115 “Specifications for Door and Frame Preparation for Hardware.”
 - 2) Locate finish hardware as indicated, if not indicated, per NBHA “Recommended Locations for Builder’s Hardware.”
 - 3) Shop paint exposed surfaces of hollow metal units, including galvanized surfaces, using manufacturer’s standard baked-on rust-inhibitive primer.

G. Doors: Comply with SDI-100, of the types and styles indicated, for materials quality, metal gages, and construction details.

- 1) Provide standard hollow metal frames for doors and other openings as indicated.
- 2) Exterior doors shall be equipped with a steel plate 12 ga. 2-1/2" x 4", with exposed corners rounded, welded to door face and ground smooth, installed at all strikes to prevent "picking" of lock by inserting a tool between door and frame.

2.07 WOOD DOORS:

A. Standard: Comply with "Industry Standard for Wood Flush Doors," published by National Woodwork Manufactures Association (NWMA) and Woodwork Institute of California (W.I.C.)

B. Warranty: "Life of Installation".

C. Fabrication:

- 1) Faces: Medium Density Overlay (M.D.O.)
- 2) Grade: Custom, Type A per W.I.C.
- 3) Core Construction: Structural Composite Lumber Core (SCLC) or Fire Rated Core (FRC)
- 4) Thickness: 1-3/4".

D. Installation: Install doors in accordance with manufacturer's instructions. Align for proper fit and uniform 1/8" clearance at head and jamb and 1/2" at sill. Machine for hardware. Seal all cut or machined surfaces. Doors shall receive 1/8" bevel in 2" at strike edge.

2.08 FINISH HARDWARE

A. Hardware Set No. 1 (Each exterior door/Panic Hdwe)

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-NL	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	ADA MORTISE CYL TURN FOR CYLINDER DOGGING	XQ13-115	626	SCH
1	EA	SURFACE CLOSER	4111 EDA MC TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	SET	WEATHERSTRIP	SUPPLY WITH DOOR AND FRAME ASSEMBLY		
1	EA	THRESHOLD	ALUMINUM		PEMK

B. Hardware Set No. 2 (Interior doors)

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	ND70TD RHO	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	SURFACE CLOSER	4111 EDA MC TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

C. Hardware Set No. 3 (Exterior Service doors)

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	LOCK	ND96TD RHO	626	SCH
1	EA	SURFACE CLOSER	4111 EDA MC TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP/HOLDER	FS43	626	IVE
1	EA	THRESHOLD 2748A X MS/A			PEMK
1	SET	WEATHERSTRIP	SUPPLY WITH DOOR AND FRAME ASSEMBLY		
1	EA	DOOR BOTTOMS	309CP		PEMK
3	EA	SILENCER	SR64	GRY	IVE
1	EA	LOCK GUARD 5000		626	TRIMCO

D. Hardware Set No. 4 (Exterior Restroom)

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FAC RESTRM W/IND CYL	ND85PD RHO	626	SCH
1	EA	SURFACE CLOSER	4011 MC TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	FS42	626	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	DOOR BOTTOMS	309CP		PEMK
1	EA	LOCK GUARD 5000		626	TRIMCO

E. KEY ALL LOCKS AS DIRECTED

2.09 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS:

A. Aluminum-Framed Entrances and storefronts, per specification section 08 41 13.

2.010 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS GLAZING:

1. Glazing Types:
 - A. 1 inch Insulated Glass with ½ inch air space –Low E
 - B. 1/4 inch Tempered Glass, (clear)
Clear fully tempered float glass.

2.011 ALUMINUM EXTERIOR SUN CONTROL DEVICES:

- A. Provide fixed Custom Sunshades System as shown on the drawings, and as needed for a complete and proper installation.
- B. Aluminum Extrusion Blades: ASTM B211, Alloy 6063-T6.
- C. Include supports, anchorage, and accessories required for complete assembly, including all attachment clips and necessary hardware for attachment to Building structure.
- D. Acceptable Products: Arcadia Brise Soleil Standard Series or Equal.
- E. Outrigger: Straight Square
- F. Louver: Rectangular Tube
- G. Fascia: Closed 6" Rectangular

2.012 WINDOW TREATMENT:

1. Provide manually operated, sunscreen and blackout roller shades as applicable:
 - A. Manual operating, chain drive, sunscreen roller shades in all exterior windows of rooms and spaces shown on the Drawings.
 - B. Manual operating interior, chain drive room darkening blackout roller shades with blackout fabric in all exterior windows of rooms and spaces shown on Drawings, and related mounting systems and accessories.

2.013 FLOORING:

- A. Floor Underlayment: 3/8" thick particle board; density: 45 lbs. per cubic foot; maximum warp 0.004 inches per foot; maximum moisture content: 8%.
- B. Vinyl Composition Tile: Armstrong "Imperial Texture Excelon" or approved equal, 12" x 12" x 1/8". Color as selected by Architect, Custom pattern with 3- Colors maximum.
- C. Rubber Topset Cove Base: 4" high with molded internal and external angles and rounded top. Topset cove base to have 1/2" projected lip at bottom. As manufactured by Burke Rubber Co., Armstrong or approved equal. Color as selected by Architect.
- D. Adhesive: Waterproof types as recommended by the manufacturer of carpet and base.
- E. Crack Filler: As recommended by Flooring manufacturer.

2.014 EXTERIOR PAINT SCHEDULE:

A. General: Provide paint systems for the various materials, as follows:

B. Concrete, Stucco:

1) Semi-Gloss Acrylic Finish: (2 Finish coats over primer)

a) Primer:

1) K-M: 247 Chem-Guard Acrylic Masonry Primer

b) First and Second Coats: Acrylic Latex, Semi-gloss Finish.

1) K-M: 1250 Acry-Lustre Acrylic, Semi-Gloss.

C. Zinc Coated Metal

1) High-gloss Acrylic Enamel: (2 Finish coats over primer)

a) Primer: Latex Metal Primer

1) K-M: 5725 DTM Acrylic Metal Primer.

c) First and Second Coats: Acrylic Latex, Semi-gloss Finish.

1) K-M: 5780 DTM Acrylic Gloss Enamel.

Ferrous Metal (Doors and Frames Pre-Primed):

Full Gloss Acrylic Enamel: (2 Finish coats over primer.)

First and Second Finish Coats: High Gloss Acrylic Enamel.

K-M: 5780 DTM Acrylic Gloss Enamel.

Wood Trim, Fascia Boards and Eaves:

Semi-Gloss Acrylic Finish: 2 Finish Coats over primer.

Prime Coat: Primer undercoat.

K-M: 255 Stain-Lock II Stain Resistant Acrylic Primer.

First & Second Finish Coats: Semi-Gloss Acrylic Finish

K-M: 1250 Semi-Gloss Acrylic

Exposed Wood Under Buildings:

One Coat:

K-M: Cabot's 9100 Clear Solution.

2.015 INTERIOR PAINT SCHEDULE:

Gypsum Wallboard Systems:

Semi-Gloss 100% Acrylic Enamel Finish: 3 coats with total dry film thickness not less than 2.5 mils.

First Coat: Interior Latex Base Primer Coat.

K-M: 971 Acry-Prime Interior Latex Primer/Sealer.

Second and Third Coats: Interior Semi-Gloss 100% Acrylic Enamel.

K-M: 1685 Dura Poxy Semi-Gloss Acrylic Enamel.

Ferrous Metal (Doors and Frames Pre-Primed):

Semi-Gloss 100% Acrylic Enamel Finish: 2 coats over primer, with total dry film thickness not less than 2.5 mils.

First Coat: Interior Enamel Undercoat.

K-M: 1685 Dura Poxy Plus semi-Gloss Acrylic Enamel.

Second Coat: Interior Semi-Gloss 100% Acrylic Enamel.

K-M: 1685 Dura Poxy Plus Semi-Gloss Acrylic Enamel.

NOTE: Paint all exposed conduits, mechanical units and electrical boxes on the exterior of the building.

2.016 WALLCOVERING:

- A. Vinyl: Wall covering Koroseal School Collection.
- B. Tackboard Panels: "Lamvin 1/2" Tackboard Panels", factory fabricated panels, "Lamvin, Inc." or approved equal, Class A fabric backed vinyls. Panels shall be installed over 1/2" gypsum wall board. All components are ASTM E84 – Class 1/A.

2.017 CEILING SYSTEM:

- A. Grid: 1-1/2" x 1" steel suspended tee-bar grid system, white.
- B. Tile: 24" x 48" Fine Fissured by Armstrong, or approved equal. NRC range .50 - .60. Class A Flame spread 0-25.
- C. Suspension System & Grid shall be subject to D.S.A. approval, and shall comply with applicable portions of Title 21, C.A.C.

D. Ceilings at toilet room modules shall be 5/8" gypsum board.

2.018 FIRE EXTINGUISHERS:

A. 2A - 10BC extinguisher in wall cabinet with break glass door and return trim for semi-recessed installation. Prime cabinet for field painting per paint schedule.

2.019 MARKERBOARDS AND TACKBOARDS:

A. Markerboard: Naco S.S. slating baked on 1/4" premium hardboard over 1/4" hardboard backing.

B. Tackboards: Vinyl Fabric-Faced, type II, mildew resistant, laminated to 1/4" thick cork backing sheet over 1/4" hardboard backing.

C. Frame Extruded aluminum at sides No. c-1.

D. Tray: Extruded aluminum at bottom, No. CRC-2B.

E. Map and Display Rail: Extruded aluminum at top with cork insert, No. M-2B.

F. Aluminum Finish: Bronze Anodized.

2.020 PREFINISHED SCIENCE CABINETS AND FURNISHINGS:

A. This section includes prefinished cabinet work including tops, splash, base and hardware. Per specification section 12 35 50.

B. Science Tables:

1) Adjustable Height Science Tables W60xD30xH27"-36", with Casters, by Diversified Woodcrafts Model P8142K or Equal.

C. Teacher's Desk:

1) Movable Teacher's Desk:

Adjustable Height Desk W60xD30xH24.5-35.5", with Casters, by Paragon Teach-IT table solutions (paragoninc.com) or Equal.

D. LAB EQUIPMENT:

1) Furnish and install all materials/equipment and perform all labor necessary for the installation of the following lab equipment:

A. Refrigerator/Freezer: GE Energy star 21.9 Cu.Ft. Top-Freezer Refrigerator, Model GIE22JSNSS (or equal).

B. Glassware Standard Washer, Undercounter, Accessible, Model 5634ADA by Universal Scientific or equal.

C. Combination Drench Shower and Halo Eyewash, Barrier Free Model S19314 Series by Bradley, or equal.

END OF SECTION 13 34 23.13

GENERAL MECHANICAL/PLUMBING/FIRE PROTECTION SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.1 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Design and engineer modular building system to be in conformance with all applicable codes, ordinances, and other regulations, including the following:
1. California Building Code (CCR, Title 24, Part 2).
 2. California Electrical Code (CCR, Title 24, Part 3).
 3. California Mechanical Code (CCR, Title 24, Part 4).
 4. California Plumbing Code (CCR, Title 24, Part 5).
 5. California Energy Code (CCR, Title 24, Part 6).
 6. California Fire Code (CCR Title 24, Part 9).
 7. California Code of Regulations, Elevator Safety Orders (CCR, Title 8, Chapter 4, Subchapter 6).
 8. U.S Justice Department's 2010 ADA Standards for Accessible Design.
 9. American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
 - a. ASHRAE 55: Thermal Environmental Conditions for Human Occupancy.
 - b. ASHRAE 62.1: Ventilation for Acceptable Indoor Air Quality.
 10. American Water Works Association (AWWA):
 11. AWWA C651: Disinfecting Water Mains.
 12. California Code of Regulations (CCR).
 13. National Fire Protection Association (NFPA):
 14. NFPA 13: Installation of Sprinkler Systems.
 15. District Design Standards (Latest Edition).

1.2 SYSTEM DESCRIPTION

- A. General: Provide a complete operational system.
1. Design, furnish and install complete and fully functioning systems for the following:
 - a. HVAC system.
 - b. Plumbing system.
 - c. Fire sprinkler system
 2. Engineer of Record (EOR) shall be responsible for:
 - a. All calculations, system concepts, equipment selections, distribution routings, coordination with other trades during design, and any other tasks needed to furnish and install complete and operating systems that meet or exceed the design performance intent.

- b. Changes required to meet the design performance intent including, but not limited to; recalculations, revisions to the system concepts, equipment reselections, distribution re-routings, re-coordination, and any other tasks needed to furnish and install complete and operating systems
 - c. Project specifications
 - d. Coordination issues for other designers and engineers of the building.
 - e. Points of connection to utility services, gas, domestic cold water, fire water, sanitary sewer for the buildings.
 3. Unless authorized in writing, all piping, conduit, and wiring to be concealed, except in those areas without a finished ceiling.
 4. Heating and cooling equipment shall be sized per room or zone use; load calculations shall be done per CEC 2019 requirements and the T-24 energy forms shall be filled out before DSA submittal.
 5. Smaller fans (less than 1 HP) shall be specified at 120V. Larger loads (larger than 1 HP) such as compressors etc., shall be specified at 208V, 1 phase or 3 phase. Equipment larger than 5 HP or larger shall be specified at 480V, 3 phase.
- B. Thermal Comfort/Air Quality Performance Level: Design and engineer mechanical systems to maintain an automatically controlled indoor air temperature of 74 deg F (± 2 deg F) in summer and 70 deg F (± 2 deg F) in winter, and to meet ASHRAE 55 thermal comfort standards. Use 0.5% outdoor design conditions for summer Median of Extremes for winter.
 1. HVAC system to provide continuous supply of outside air per Chapter 4 of the California Mechanical Code.
 2. Design and engineer HVAC system to meet requirements of ASHRAE 62.1, CBC and CEC for outside air ventilation.
- C. Energy Performance: Design and engineer prefabricated building system to conform with all requirements of the California Energy Code. Design criteria of the dry system shall be:
 1. Supply ducts shall be designed with the equal friction method, 0.07"/100; for main ducts (not to exceed 2000 ft/min). Flex ducts shall not exceed 5 feet in length and shall occur only at connections to concealed diffusers or grilles.
 2. Return ducts shall be designed with the equal friction method at 0.07"/100ft (not to exceed 1,500 ft/min). Design plenum return air systems for low pressure drops. Design transfer air systems at 250 ft/min to minimize pressure drops.
 3. Outside air intake and relief louvers shall be designed for maximum 400 fpm air velocity.
 4. Maximum velocity through un-ducted plenum return elements shall not exceed 700 fpm.
 5. Duct layout shall emphasize the use of 45 degree branch takeoffs and wye ("pant-leg") fittings for duct splitting. Whenever a 90 degree bend is required, round duct with a minimum 1 1/2 times radius is preferred.
 6. Care shall be taken for all exposed ducts to preserve clean lines and appearance. Ducts shall be connected using internal sleeves and any visible

excess duct sealant shall be removed quickly after assembly. Ducts shall be free of any dents, dings or other markings.

7. Fire smoke dampers and backdraft dampers shall be sized for a pressure drop less than 0.02" w.g.
 8. Locate rooftop package units and/or air handlers so that supply air discharge is directly over shafts wherever possible. Exposed ductwork on the roof should be avoided.
 9. All rooftop HVAC units shall be balanced to allow operation at lowest possible static pressure that will deliver design CFM.
 10. Airside balancing must be conducted so that at least one balancing damper is fully open. Air systems with all dampers partially closed indicates a system that requires a lower fan RPM and this condition is not acceptable.
- D. Noise Levels: Maximum indoor noise levels with all mechanical, lighting, and electrical equipment operating shall not exceed 35 dBA when occupied.

1.3 REQUIRED DOCUMENTS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of the following prefabricated building system components:
1. Plumbing equipment, fixtures, valves, piping, trim, and sizing calculations.
 2. Building fire sprinkler system.
 3. HVAC equipment, registers, ductwork, and load calculations.
 4. Title 24 energy compliance report.
- B. Shop Drawings: For prefabricated building system. Include plans, elevations, sections, details, and attachments to other work. Prefabricated building manufacturer is responsible for obtaining approval from the Division of the State Architect prior to start of fabrication.
1. Fire Sprinklers: Floor plans and reflected ceiling plans showing pipe sizes, layouts, fittings, valves, equipment, and other components.
 - a. Include hydraulic analysis data indicating compliance with design criteria, signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Mechanical Drawings:
 - a. Floor plans showing equipment locations, duct routing and sizes, balancing dampers, register locations and sizes, supply and return air volumes, access panels, and all other components of the Mechanical system.
 - b. Details showing equipment mounting, duct supports, register mounting, and any required seismic bracing.
 - c. Mechanical equipment control diagrams and sequences of operation.
 3. Plumbing Drawings:

- a. Floor plans showing plumbing fixture locations, water heater locations, pipe routing, pipe sizes, trap primers, water hammer arrestors, valves, access panels, and all other components of the Plumbing system.
 4. Details showing fixture mounting, water heater piping diagram, water heater seismic supports, pipe supports/hangers, and any required seismic bracing.
- C. Energy Calculations: Signed and sealed by qualified professional engineer; showing compliance with Title 24 requirements for the following:
1. Building envelope.
 2. Lighting.
 3. HVAC.

PART 2 - PRODUCTS

2.1 FIRE SPRINKLERS

- A. Fire Sprinkler System: Complete automatic wet-pipe sprinkler system complying with requirements of NFPA 13, designed for occupancy as determined therein, and with requirements of local Fire Department.
1. All components of fire sprinkler system to be listed by Underwriters Laboratories, and approved by all agencies having jurisdiction.
 2. Unless authorized in writing by Architect, all piping to be concealed, except in those areas without a finished ceiling.
 3. Where occurring in areas with suspended lay-in ceiling panels, sprinkler heads to be centered within panel.
 - a. If occurring within panel with bisecting scoreline, center sprinkler head within simulated two ft by two ft module.
 4. Submittal: Submit two (2) of each type of sprinkler head for Owner review prior to actual construction.
- B. Verify water supply information (e.g. static and residual pressure) with utility company supplying water, and that information provided by utility company is acceptable as basis for design.
1. For bidding purposes, assume water pressure at base of riser is 35 psi.
- C. Coordinate point of connection to onsite underground fire line with Owner's separate contractor.
- D. Sprinkler Heads: Unless noted otherwise, all heads to have temperature rating of 165 deg F; where near heating-emitting devices, adjust temperature setting to eliminate false alarms.
1. Exposed Ceiling Construction: Exposed upright automatic fusible link type, plain brass finish, Tyco TY-FRB or equal.
 2. Concealed: Concealed pendant automatic fusible line type, Tyco Royal Flush II, or equal.

3. Recessed: Recessed pendant automatic pendant fusible link type, Tyco TY-FRB or equal.
 4. Recessed Sidewall: Horizontal sidewall automatic fusible link type; Tyco TY-FRB or equal.
- E. Riser Drain: The riser main drain shall discharge indirectly to a sanitary sewer drain or to a vegetated area. Sanitary sewer drain shall have enough capacity to accommodate an annual main drain test in accordance with NFPA 25.
- F. In Building Riser: The In Building riser shall be one piece stainless steel Ames IBR or equal.

2.1 PLUMBING

- A. Furnish a complete plumbing system including all waste, vent, water, gas, and roof drainage piping. Include all valves, roof and overflow drains, floor drains, trap primers, water hammer arrestors, hose bibs, and any other components required for a complete plumbing system.
- B. All potable water system materials shall comply with NSF/ANSI Standard 61, Annex G for low lead requirements of 0.25% lead content.
- C. The Drawings and Specifications do not attempt to list every item that must be installed. When an item is necessary for the satisfactory operation of equipment, is required by the equipment manufacturer, or accepted as good practice, furnish without change in Contract cost.
- D. At the start of the project, Plumbing Contractor shall schedule a coordination meeting between Fire Protection, Mechanical, Plumbing, and Electrical sub-contractors at a minimum. Meeting shall review voltage and phase available at site and power requirements for each piece of equipment, location of each piece of equipment, all control panels, gas pressure regulator capacities and sizes, building utilities to site utility connections and any and all equipment requiring coordination between trades. Minutes of the meeting shall be recorded and forwarded to the School District, Fire Protection, Mechanical, Plumbing and Electrical sub-contractors, whether present at the meeting or not.
- E. Piping:
1. Hot and Cold Water Piping:
 - a. Above ground shall be Hard copper water tube, conforming to ASTM B88 (Type "K" underground, Type "L" above ground) with wrought copper fittings.
 - b. Hot water piping shall have 1" thick Owens-Corning ASJ/SSLII (all service jacket with pressure sensitive tape closure system), average thermal conductivity at 70°F mean temperature, 0.23 per inch of thickness. Seal longitudinal joints with SSLII closure system and seal butt joints with 3" tab. Fittings to be pre-formed, factory fabricated of same materials and covering as insulation, seal butt joints with 3" tabs. Insulation for runouts

shall comply with Table 123-A of the California Energy Efficiency Standards.

- c. All valves shall be the product of a single manufacturer, 300 PSI air and water rated. All valves shall be low lead type per NSF/ANSI standard 61.

2. Sanitary Sewer, Roof Drainage, and Vent Piping:

- a. Above grade shall be service weight no-hub cast iron per CISPI 301-09, with neoprene sleeve and stainless steel clamps with a stainless steel shield which shall completely cover the neoprene per CISPI 310-04. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and pipe, fittings and couplings shall be listed by NSF international.
- b. Below grade shall be ABS DWV (SDR 35) per ASTM 2751 and shall be IAPMO approved with solvent weld socket fittings.

3. Acid Waste Piping:

- a. Waste piping from laboratory sinks shall be Charlotte Pipe ChemDrain acid resistive piping.

4. Gas Piping:

- a. Above Grade Interior Piping: ASTM A53B seamless, Schedule 40, carbon steel pipe.
- b. Above Grade Exterior Piping: ASTM A53B seamless, Schedule 40, carbon steel pipe, hot dipped and galvanized coating.
- c. Above Grade Fittings: 150# black malleable iron fittings and threaded joints for pipes 2" and smaller, butt welded joints for pipes 2 1/2" and larger. Hot dipped and galvanized coating for exterior fittings.
- d. Press fittings shall be permitted for use where approved by local authorities having jurisdiction and in compliance with current codes.

5. Condensate Drain:

- a. Condensate drain piping shall be hard copper water tube, conforming to ASTM B88 (Type "K" underground, Type "L" above ground) with wrought copper fittings.
- b. Condensate drain piping draining a cooling coil shall be insulated inside building with 1" thick Owens-Corning ASJ/SSLII all service jacket with pressure sensitive tape closure system.

F. Plumbing Fixtures:

- 1. Furnish complete with fittings, supports, fastening devices, faucets, valves, traps, caulking, and appurtenances as required. Fixture locations as shown on Architectural Drawings.
- 2. Water Closet:
 - a. Fixture: American Standard AFWall Millennium 2257.101.
 - b. Carrier: Zurn or Watts.
 - c. Seat: American Standard 5901.100SS.
 - d. Flush Valve: Sloan Royal 111ESS-1.28-TMO-HW.

3. Lavatories:
 - a. Fixture: American Standard Lucerne 0356.421.
Concealed supports.
 - b. Carrier: Jay R Smith Figure no. 0700.
 - c. Faucet: Chicago Faucets 116.121.AB.1.
 - d. Drain: McGuire 155WC.
 - e. Trap: Traps shall be chromium plated 17 gauge cast brass.
 - f. ADA under sink covers: Truebro LavGuard.
 4. Custodian Mop Sinks:
 - a. Fixture: American Standard Florwell 7741.000.
 - b. Faucet: Chicago faucets 540-LD897SWXFABCP.
 5. Hose Bibb:
 - a. Fixture: Acorn 8121CP-LF with loose tee key operation and vacuum breaker.
 6. Floor Drain:
 - a. Fixture: Jay R. Smith Fig. 2005Y with 5" diameter strainer, 1/2" trap primer connection and nickel bronze strainer.
 7. Lab Sink:
 - a. Fixture: Integral to counter
 - b. Faucet: Chicago Faucets 786-E7CP
 8. Gas Turret:
 - a. Fixture: Chicago Faucets LGB1-31C-10
 9. Emergency Shower and Eyewash
 - a. Fixture: See Architect's drawings
 - b. Floor Drain: Jay R. Smith or Zurn with trap primer.
 - c. Trap Primer: Precision Plumbing Products electronic trap primer with schedule timer.
 - d. Mixing Valve: Haws scald prevention thermostatic mixing valve.
- G. Water Heater:
1. Provide wall mounted tankless gas-fired water heater with circulation pump.
 2. Manufacturers: Provide units by one of the following:
 - a. Intelli Hot.
 - b. Navien.
- H. Shock Absorbers:
1. Provide on hot and cold water lines at quick closing valves such as flush valves, solenoid valves, etc.
 2. Sized and located in accordance with Plumbing and Drainage Institute Manual WH 201.

3. Provide access panels at locations where shock absorbers are not accessible. Types and locations to be approved by the Architect.
- I. Site Utility Connections: Coordinate with Owner's separate contractor for connection to onsite underground utility lines.
 1. Water: Include needed pressure-reducing valves and shut-off valves.
 2. Sanitary Sewer: Include cleanouts; verify invert elevations at point of connection prior to installation of any sewer lines.
 3. Condensate Drains: Connect to locations approved by local jurisdictions.
 - J. All equipment, piping, and materials shall be fastened and securely anchored to building structure as required by the Drawings, Specifications, OSHPD Preapproval of Manufacturer's Certification OPM-0043-13 and OPM-0052-13, and the California Building Code.
 - K. Escutcheons:
 1. Provide stainless steel escutcheons at piping penetrations of walls where exposed public view and required for proper appearance. Provide galvanized steel escutcheons at penetrations of masonry walls elsewhere. Escutcheons not generally required at drywall penetrations where not exposed to public view.
 - L. Sleeves:
 1. Provide sleeves where pipes pass through floors above grade, roofs, poured-in-place masonry walls, and exterior walls.
 2. Sleeves shall be standard weight steel pipe, except sleeves for concealed piping through floors not in structural members may be 25-gauge galvanized sheet metal.
 3. Floor sleeves for piping shall extend from the bottom of the slab to 2-inches above the finished floor.
 4. Seal between piping and sleeve with fire-rated caulk at all penetrations of fire-rated partitions and floors.
 5. Sleeves that pass through structural expansion joint areas shall be oversized to accommodate the building and pipe movement. Coordinate required sleeve size and building movement with Structural Engineer.
 6. Make sleeves through outside walls watertight. Caulk between uninsulated pipe and sleeve.

2.2 HVAC

- A. The Drawings and Specifications do not attempt to list every item that must be installed. When an item is necessary for the satisfactory operation of equipment, is required by the equipment manufacturer, or accepted as good practice, furnish without change in Contract cost.

- B. At the start of the project, Mechanical Contractor shall schedule a coordination meeting between Fire Protection, Mechanical, Plumbing, and Electrical sub-contractors at a minimum. Meeting shall review voltage and phase available at site and power requirements for each piece of equipment, location of each piece of equipment, all control panels, and any and all equipment requiring coordination between trades. Minutes of the meeting shall be recorded and forwarded to the Architect, Fire Protection, Mechanical, Plumbing and Electrical sub-contractors, whether present at the meeting or not.
- C. Packaged rooftop air conditioning units:
1. Backward inclined, centrifugal type fan with airfoil-type blades.
 2. Filter media: UL 900 listed, Class I or Class II, approved by local authorities. All filters shall be MERV 13, 2" thick.
 3. Air-cooled packaged air conditioning equipment shall be equipped with low ambient cooling if systems are not provided with economizers or if systems serve a 24/7 load.
 4. All units shall have a dedicated set of minimum outside air dampers for ventilation requirements. Modulating outside air dampers shall be provided as required for economizer operation or tracking with exhaust air.
 5. Rooftop package air conditioners 5 ton and larger shall be mounted on structural steel curbs with curb vibration isolation rails. Smaller units may be mounted on the manufacturer's prefabricated curbs.
 6. Coils shall be copper coils with aluminum fins.
 7. Units shall be installed to allow removal of all coils and filters. Clearance equal to full-finned width of coil shall be provided.
 8. All cooling coil drain pans shall be stainless steel.
 9. All units shall have low leak economizers with fault detection diagnostics.
 10. Units shall be fitted with control modules to allow demand control ventilation.
 11. All units shall have power exhaust fans. Power exhaust shall have separate power connection per NEC requirements. Power exhaust shall be capable of relieving 100% of the supply air. Power exhaust shall be controlled by space pressure.
- D. Exhaust fans:
1. Exhaust ducts to run above ceiling from ceiling mounted exhaust fan to exit through roof with roof cap.
 2. Roof mounted exhaust fans to include sound attenuating roof curb. Exhaust ducts to run above ceiling to ceiling mounted exhaust register.
- E. Split system: Provide complete system with hard-wired controls, factory line sets, chlorine free (R410a) refrigerant, and ready for field connections.
1. Manufacturer: Provide units by one of the following:
 - a. Mitsubishi
 - b. Daikin
 - c. Carrier

- F. HVAC System: Furnish a complete system including all packaged air conditioning units, split systems, exhaust fans, ductwork, piping, filters, and all other needed components, capable of meeting specified performance criteria for thermal comfort and air quality. The requirements of ASHRAE Standard 62.1 shall be incorporated into the design. Design system so each zone is serviced by dedicated HVAC unit; zones are defined as follows:
1. Any heating and cooling equipment shall be sized per classroom use, load calculations shall be done per CEC 2019 requirements and the T-24 energy forms shall be filled out before DSA submittal.
 2. Smaller fans (less than 1 HP) shall be 115 V/ Single phase and other loads requiring larger loads such as compressors etc., shall be 208 V/ 3 phase, 480 V/3 phase and 208V/ single phase also shall be available for the equipment)
 3. Classrooms – Packaged rooftop air conditioning unit. Exhaust fan sized for 1 cfm / sf.
 - a. Manufacturer of rooftop ac units
 - i) Trane
 - ii) Carrier
 - iii) York
 - b. Manufacturer of exhaust fans
 - i) Greenheck
 - ii) Loren Cook
 4. Prep Rooms – Split system heat pump. Exhaust fan sized for 1 cfm / sf.
 - a. Manufacturer of split system
 - i) Trane-Mitsubishi
 - ii) Samsung
 - iii) Daikin
 - b. Manufacturer of exhaust fans
 - i) Greenheck
 - ii) Loren Cook
 5. Staff restroom – Exhaust only, 12 air changes per hour.
 - a. Manufacturer of exhaust fans
 - i) Greenheck
 - ii) Loren Cook
 6. Custodian – Exhaust only, 12 air changes per hour.
 - a. Manufacturer of exhaust fans
 - i) Greenheck
 - ii) Loren Cook
 7. Electrical / IDF room – Dedicated split system cooling only unit.
 - a. Manufacturer of split system
 - i) Trane-Mitsubishi

- ii) Samsung
- iii) Daikin

G. Refrigerant Piping Installation:

1. Install refrigeration specialties in accordance with manufacturer's instructions.
2. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
3. Install piping to conserve building space and avoid interference with use of space.
4. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
5. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
6. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.
7. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
8. There should not be any refrigerant piping belowground.
9. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
10. Piping may be run exposed on the roof provided:
 - a. It is supported 18" above the roof (for re-roofing) on seismically braced struts.
 - b. Insulation is protected from weather (jacketed with aluminum).
 - c. The overall height of piping is not visible from the street level or from any window.
 - d. It does not interfere with access to any equipment on the roof.
 - e. It is covered with aluminum jacketing.

H. Filters: Filters shall be 2" Merv-13 filters. Velocity through the filters shall be between 300 ft/min and 350 ft/min

I. Ductwork:

1. Construction of ductwork shall be galvanized sheetmetal of thickness recommended in Table 2-3 of the latest edition of the SMACNA HVAC Duct Construction Standards, for 2" w.g., 2500 FPM maximum velocity, except no ducts shall be less than 24 gauge. Fabricate in accordance with SMACNA Standards.
2. Flexible ducts shall consist of an exterior reinforced laminated vapor barrier, 1 1/2" thick, 3/4 lbs density fiberglass insulation ($U = 0.23$ at 50°F) encapsulated spring steel wire helix and impervious, smooth, non-perforated interior vinyl liner. Duct shall be rated for 2" (positive), 0.5" (negative), 4000 FPM velocity

and 180°F. Flame spread of not over 25, smoke developed of not over 50. Duct shall conform to requirements for Class I, UL 181 and UL 181B, and NFPA 90A and 90B. Flexible ductwork shall be installed with no runs more than 5'-0" and no more than one (1) bend of 45° maximum. Flexible ductwork shall be used only at register connections.

3. Duct Insulation: All duct insulation shall comply with Section 124, requirements for air distribution system ducts and plenums, 2019 Building Energy Efficiency Standards, California Code of Regulations, Title 24, Part 6.
 4. Manufacturers: Owens Corning, Johns Manville, Knauf or equal.
 5. Insulation shall:
 - a. Meet minimum thickness requirements of Chapter 2-53 of Title 24 and CMC 604.1.
 - b. Meet mold, humidity, and erosion resistance requirements of CMC Standard 6-1
 - c. Have flame spread not more than 25 and smoke density of not more than 50 when tested as a composite installation per CMC 604.3.
 6. Ductwork shall be insulated as follows:
 - a. In concealed space, including ceiling plenum: Shall be insulated with 1-1/2" Fiberglass, 3/4 lb./cuft faced Duct Wrap.
 - b. Exposed to outdoors: Shall be internally lined with Certainteed Toughgard Duct Liner, 1-1/2 lb. density, 2" thick. (Exposed ductwork should be avoided).
 - c. At fan inlet and discharge, where required for acoustical attenuation: Shall be internally lined with Certainteed Toughgard Duct Liner, 1-1/2 lb. density, 1" thick.
 - d. Longitudinal joints shall be stapled. For rectangular ducts exceeding 24 inches, insulation on the bottom shall be additionally secured with adhesive.
 - e. Project shall not have exposed ductwork, if there is a deviation on design intent then insulation exposed to weather shall be protected by a smooth or corrugated aluminum jacket, minimum 0.016 inch thick, secured 3" on center, overlapped at joints and sealed watertight.
- J. Controls: A complete system shall be provided. System shall include components required to provide temperature and ventilation control for each zone. Provide code required demand control ventilation controls as required references and codes listed on this document.
1. Rooftop air conditioning units: Pelican Thermostats with CO2 Controls.
 2. Rooftop unit power exhaust: Space pressure sensor.
 3. Exhaust fans serving toilets and custodian: Run during school hours with occupancy sensor.
 4. Classroom and prep room Exhaust fans: Wall switch.
 5. Split system cooling in IDF: Hard wired wall mounted factory controller.

6. Split system heat pumps: Pelican Thermostats with required thermostat adapter.

K. Air balance:

1. The Mechanical Contractor shall procure the services of an independent air balance and testing agency, approved by the Architect, which specializes in the balancing and testing of heating and ventilating systems to balance, adjust, and test air moving equipment, air distribution, and exhausting systems as herein specified. All work by this agency shall be done under direct supervision of a qualified test and balance engineer employed by them. Engineer/Agency shall be NEBB and/or AABC certified. All instruments used by this agency shall be accurately calibrated and maintained in good working order. If requested, the tests shall be conducted in the presence of the Architect and/or his/her representative or the Owner's representative.
2. Test and balance agency shall include in its work allowance for the project a one year warranty, during which time the Owner, at his/her discretion, may request a recheck or resetting of any outlet, supply air fan or exhaust fan as listed in the test report. The agency shall provide technical personnel to assist the Architect in any tests he may require during this period of time.
3. Adjust, balance and test air systems to achieve and confirm compliance with Drawings and Specifications. Prepare complete report of final test results and submit seven (7) copies to Contractor for forwarding to Architect for review and approval. Prior to submitting it to the Architect, the Mechanical Contractor shall stamp and sign the cover page indicating he has reviewed the report and concurs with the findings. The report shall also be signed by the supervising test and balance engineer.

L. Acoustic Performance:

1. It is the intent of this Specification that noise levels due to air conditioning and/or ventilating equipment, ducts, grilles, registers, diffusers, dampers, boxes, etc. will permit attaining sound pressure in all eight octave bands in occupied spaces conforming to the following NC (noise criteria) curves, as explained in the latest issue of the ASHRAE Handbook and Product Directory Systems:

Occupancy	Preferred	Alternate
Classrooms	RC 25-30(N)	NC 30-35
Toilet rooms	RC 35-40(N)	NC 40-45

2. All fan duct connections should be flexible.
3. There should be a minimum straight duct run of 2 duct diameters on flow changing elements and elbows before and after each element.
4. Flow changing elements and elbows should not be used closer than two duct diameters from the outlet or inlet of a fan or a diffuser, register or grille.
5. Supply ducts immediately downstream of fans should have the same dimensions as the fan discharge opening for a length of

6. 1.5 times the largest discharge duct dimension.
7. Transition sections of duct should have slopes not greater than 1 in 4.
8. Flexible duct used for connecting a branch duct to a register, grille, diffuser should be insulated and should be no more than 5' in lineal length.
9. Fan powered boxes, etc., should not be installed in the ceiling plenums of Acoustically Important (NC<35) spaces. If equipment must be installed in Acoustically Important Spaces, it is probable that significant noise control, such as gypsum board enclosures or ceilings, will be required to meet the background noise criteria.
10. Diffusers, registers and grilles should be chosen for a total performance Noise Criteria (NC) value of at least five points below the room NC goals. The manufacturer's NC rating of the selected device, used for comparison with the NC goals, should include the NC contributions of all individual units within the space along with all appropriate adjustments for face velocity, device length, device area, the presence of dampers

M. Sound level tests:

1. Upon completion of testing and balancing of air systems, conduct sound level tests of conditioned spaces. Use approved calibrated octave band analyzer and record sound levels in db for each of the eight (8) octave bands. Record the following data for each room and system.
 - a. Background sound level (systems off).
 - b. Sound level heating (systems operating).
 - c. Sound level cooling (systems operating).
 - d. Record data on outdoor sound levels at HVAC equipment locations as directed by the Architect.
2. If sound level at any observation point exceeds specified levels, the Contractor shall take remedial action as directed by the Architect. Additions of sound traps, insulation or dampers shall be made by the Air Conditioning Contractor under the direction of the sound balancing agency and at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Installation: All the installation shall be done strictly with installation manuals and shall meet current codes. Operational set points shall be coordinated with owner and adjusted accordingly. Document all the installation start-ups, coordination and set points. Send these documentation to owner rep within 10 business day after activity completed.
- B. Testing by Prefabricated Building Manufacturer:
1. Water Piping Hydrostatic Tests: Test at not less than 125 psig for four hours prior to closing in of piping with finish materials. Fill pipelines 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

- a. Testing shall show no loss in pressure.
 - b. Prepare reports of testing activities.
- C. Owner will engage a qualified testing and inspecting agency to perform other tests and inspections and submit reports.
- D. Correct deficiencies in Work that test and inspection reports indicate do not comply with specified requirements.
- 1. Retest corrected work to verify compliance with specified requirements.

3.2 Identification for HVAC Piping and Equipment

- A. Provide mechanical identification of all mechanical equipment, including ductwork, piping, valves, and mechanical equipment.
- B. Adhere to ANSI A-13

3.3 ADJUSTING

- A. Mechanical Equipment: Check, test, and start each item of mechanical equipment by an authorized representative of the equipment manufacturer.
 - 1. Provide copies of completed check, test, and start report for each item of equipment.

3.4 COMMISSIONING

- 1. The installing Contractor of a particular system or equipment is responsible for the commissioning activities relating to that system or equipment item and shall include pricing in their bid.
- 2. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides System Readiness Checklists and Functional Test Procedures for Contractor's use.
- 3. The following systems shall be commissioned:
 - a. HVAC System and Controls
 - b. Domestic Hot Water Systems
 - c. Lighting Controls
- 4. Design Review Submittals: Commissioning requires a Commissioning Design Review at 50% CD phase. Contractor to provide drawings to Commissioning Agent for review. Contractor shall provide feedback and incorporate comments into final drawings. Contractor shall also provide drawings at 100% CD for Commissioning Agent to conduct back-check for comment incorporation.
- 5. Commissioning requires Commissioning Agent to conduct a submittal review of all equipment included in commissioning scope. Contractor to provide submittals to Commissioning Agent for review.
- 6. Updated Submittals: Keep the Commissioning Agent informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

7. O & M manuals: Submit manuals related to items that were commissioned to Commissioning Agent for review; make changes recommended by Commissioning Agent within 60 days of submittals approval.
8. Provide all standard testing equipment required to perform start-up and initial checkout and required functional performance testing.
9. Cooperate with the Commissioning Agent in development of the System Readiness Checklists and Functional Test Procedures. Furnish additional information requested by the Commissioning Agent.
10. Contractors to attend commissioning meetings necessary to facilitate the commissioning process.
11. Prepare a schedule for mechanical system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Agent; update the schedule as appropriate.
12. Submit TAB report for Commissioning Agent review prior to functional testing.
13. Perform the Functional Tests directed by the Commissioning Agent for each item of equipment or other assembly to be commissioned. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Agent.
14. Commissioning Agent will provide a list of deficiencies after the functional testing and warranty period. The Contractor is responsible for making corrections and providing Commissioning Agent verification. The Commissioning Agent will only return 1 time for re-testing. Any additional testing will be back-charged to the Contractor.
15. Provide classroom and hands-on training of District's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned.
16. Provide support for any necessary off-season testing.
17. Contractor's qualified person or agency is responsible to filling-out California Energy Commission NRCA forms.

3.5 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction, or if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable accessories and systems including mechanical/ plumbing systems.

SECTION 260500

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 Description of Work:

- A. The work of this Section consists of providing all required labor, supervision, materials and equipment to satisfactorily complete all electrical installations that are shown on the Drawings, included in these specifications, or otherwise needed for a complete and fully operating facility.
- B. Furnish and install all required in-place equipment, conduits, conductors, cables and any miscellaneous materials for the satisfactory interconnection and operation of all associated electrical systems.

1.02 Related Work:

- A. This Section provides the basic Electrical Requirements which supplement the General Requirements of Division 01 and apply to all Sections of Division 26.

1.03 Submittals:

- A. As specified in Division 01. Submit to the Architect shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system specified. Information to be submitted includes manufacturer's descriptive literature of cataloged products, equipment, drawings, diagrams, performance and characteristic curves as applicable, test data and catalog cuts. Obtain written approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review. Furnish manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable Federal, Industry and Technical Society Publication References, and years of satisfactory service of each item required to establish contract compliance. Photographs of existing installations and data submitted in lieu of catalog data are not acceptable and will be returned without approval.
- B. Organize submittals for equipment and items related to each specification section together as a package.
- C. Proposed substitutions of products will not be reviewed or approved prior to awarding of the Contract.
- D. Substitutions shall be proven to the Architect or Engineer to be equal or superior to the specified product. Architect's decision is final. The Contractor shall pay all costs incurred by the Architect and Engineer in reviewing and processing any proposed substitutions whether or not a proposed substitution is accepted.
- E. If a proposed substitution is rejected, the contractor shall furnish the specified product at no increase in contract price.
- F. If a proposed substitution is accepted, the contractor shall be completely responsible for all dimensional changes, electrical changes, or changes to other work which are a result of the substitution. The accepted substitution shall be made at no additional cost to the owner or design consultants.

1.04 Quality Assurance:

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- A. Codes: All electrical equipment and materials, including installation and testing, shall conform to the latest editions following applicable codes:
 - 1. California Electrical Code (CEC).
 - 2. Occupational Safety and Health Act (OSHA) standards.
 - 3. All applicable local codes, rules and regulations.
 - 4. Electrical Contractor shall possess a C-10 license and all other licenses as may be required. Licenses shall be in effect at start of this contract and be maintained throughout the duration of this contract.
- B. Variances: In instances where two or more codes are at variance, the most restrictive requirement shall apply.
- C. Standards: Equipment shall conform to applicable standards of American National Standards Institute (ANSI), Electronics Industries Association (EIA), Institute of Electrical and Electronics Engineers (IEEE), and National Electrical Manufacturers Association (NEMA).
- D. Underwriter Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Provide service entrance labels for all equipment required by the NEC to have such labels.
- E. The electrical contractor shall guarantee all work and materials installed under this contract for a period of one (1) year from date of acceptance by owner.
- F. All work and materials covered by this specification shall be subject to inspection at any and all times by representatives of the owner. Work shall not be closed in or covered before inspection and approval by the owner or his representative. Any material found not conforming with these specifications shall, within 3 days after being notified by the owner, be removed from premises; if said material has been installed, entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the contractor.

1.05 Contract Documents:

- A. Drawings and Specifications:
 - 1. In the case of conflict between the drawings and specifications, the specifications shall take precedence.
 - 2. Drawings and specifications are intended to comply with all law, ordinances, rules and regulations of constituted authorities having jurisdiction, and where referred to in the Contract Documents, said laws, ordinance, rules and regulations shall be considered as a part of said Contract Documents within the limits specified. The Contractor shall bear all expenses of correcting work done contrary to said laws, ordinance, rules and regulations if the Contractor knew or should have known that the work as performed is contrary to said laws, ordinances, rules and regulations and if the Contractor performed same (1) without first consulting the Architect for further instructions regarding said work and/or (2) disregarded the Architect's instructions regarding said work.
- B. Drawings: The Electrical Drawings shall govern the general layout of the completed construction.
 - 1. Locations of equipment, panels, pullboxes, conduits, stub-ups, ground connections are approximate unless dimensioned; verify locations with the Architect prior to installation.

2. Review the Drawings and Specification Divisions of other trades and perform the electrical work that will be required for those installations.
3. Should there be a need to deviate from the Electrical Drawings and Specifications, submit written details and reasons for all changes to the Architect for approval.
4. The general arrangement and location of existing conduits, piping, apparatus, etc., is approximate. The drawings and specifications are for the assistance and guidance of the contractor, exact locations, distances and elevations are governed by actual field conditions. Accuracy of data given herein and on the drawings is not guaranteed. Minor changes may be necessary to accommodate work. The contractor is responsible for verifying existing conditions. Should it be necessary to deviate from the design due to interference with existing conditions or work in progress, claims for additional compensation shall be limited to those for work required by unforeseen conditions as determined by the Architect.
5. All drawings and divisions of these specifications shall be considered as whole. The contractor shall report any apparent discrepancies to the Architect prior to submitting bids.
6. The contractor shall be held responsible to have examined the site and compared it with the specifications and plans and to have satisfied himself as to the conditions under which the work is to be performed. He shall be held responsible for knowledge of all existing conditions whether or not accurately described. No subsequent allowance shall be made for any extra expense due to failure to make such examination.

1.06 Closeout Submittals:

- A. Manuals: Furnish manuals for equipment where manuals are specified in the equipment specifications or are specified in Division 01.

1.07 Coordination:

- A. Coordinate the electrical work with the other trades, code authorities, utilities and the Architect.
- B. Provide and install all trenching, backfilling, conduit, pull boxes, splice boxes, etc. for all services to the locations indicated on the Drawings.
- C. Contractor shall pay all inspection and other applicable fees and procure all permits necessary for the completion of this work.
- D. Where connections must be made to existing installations, properly schedule all the required work, including the power shutdown periods.
- E. When two trades join together in an area, make certain that no electrical work is omitted.

1.08 Job Conditions:

- A. Operations: Perform all work in compliance with Division 01.
 1. Keep the number and duration of power shutdown periods to a minimum.
 2. Show all proposed shutdowns and their expected duration on the construction schedule. Schedule and carry out shutdowns so as to cause the least disruption to operation of the Owner's facilities.

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3. Carry out shutdown only after the schedule has been approved, in writing, by the owner. Submit power interruption schedule 15 days prior to date of interruption.

- B. Construction Power: Unless otherwise noted in Division 01 of these specifications, contractor shall make all arrangements and provide all necessary facilities for temporary construction power from the owner's on site source. Energy costs shall be paid for by the Owner.
- C. Storage: Provide adequate storage for all equipment and materials which will become part of the completed facility so that it is protected from weather, dust, water, or construction operations.

1.09 Damaged Products:

- A. Notify the Architect in writing in the event that any equipment or material is damaged. Obtain approval from the Architect before making repairs to damaged products.

1.10 Locations:

- A. General: Use equipment, materials and wiring methods suitable for the types of locations in which they are located.
- B. Dry Locations: All those indoor areas which do not fall within the definition below for Wet Locations and which are not otherwise designated on the Drawings.
- C. Wet Locations: All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.

1.11 Safety and Indemnity:

- A. The Contractor is solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continually and not be limited to normal working hours. The contractor shall provide and maintain throughout the work site proper safeguards including, but not limited to, enclosures, barriers, warning signs, lights, etc. to prevent accidental injury to people or damage to property.
- B. No act, service, drawing review or construction review by the Owner, the Engineer or their Consultants is intended to include reviews of the adequacy of the Contractors safety measures in or near the construction site.
- C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify, and defend the Owner, the Engineer, their consultants, and each of their officers, agents and employees from any and all liability claims, losses, or damage arising out of or alleged to arise from bodily injury, sickness, or death of a person or persons and for all damages arising out of injury to or destruction of property arising directly or indirectly out of or in connection with the performance of the work under this Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the construction contract documents, but not including liability that may be due to the sole negligence of the Owner, the Engineer, their Consultants or their officers, agents and employees.
- D. If a work area is encountered that contains hazardous materials, the contractor is advised to coordinate with the owner and it's abatement consultant for abatement of hazardous material by the Owner's Representative. "Hazardous materials" means any toxic substance regulated or controlled by OSHA, EPA, State of California or local rules, regulations and laws. Nothing herein shall be construed to create a liability for Aurum Consulting Engineers regarding hazardous materials abatement measures, or discovery of hazardous materials.

1.12 Access Doors:

- A. The contractor shall install access panels as required where floors, walls or ceilings must be penetrated for access to electrical, control, fire alarm or other specified electrical devices. The minimum size panel shall be 14" x 14" in usable opening. Where access by a service person is required, minimum usable opening shall be 18" x 24".
- B. All access doors installed lower than 7'-0" above finished floor and exposed to public access shall have keyed locks.
- C. Where specific information or details relating to access panels differ from Division 26 paragraph 1.12 of these specifications, or shown on the electrical drawings and details or under other Divisions of work, those requirements shall supersede these specifications.

1.13 Arc Flash:

- A. The contractor shall install a clearly visible arc flash warning to the inside door of all panelboards and industrial control panels, as well as to the front of all switchboards and motor control centers that are a part of this project.
- B. The warning shall have the following wording: line 1 "WARNING" (in large letters), line 2 "Potential Arc Flash Hazard" (in medium letters), line 3 & 4 "Appropriate Personal Protective Equipment and Tools required when working on this equipment".

1.14 Emergency Boxes:

- A. All boxes and enclosures for emergency circuits shall be permanently marked with a readily visible red spray painted mark.

PART 2 - PRODUCTS

2.01 Standard of Quality:

- A. Products that are specified by manufacturer, trade name or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are established to be equal to the specified product and approved by the Architect prior to installation.
- B. Material and Equipment: Provide materials and equipment that are new and are current products of manufacturers regularly engaged in the production of such products. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period includes use of equipment and materials of similar size under similar circumstances. For uniformity, only one manufacturer will be accepted for each type of product.
- C. Service Support: Submit a certified list of qualified permanent service organizations including their addresses and qualification for support of the equipment. These service organizations shall be convenient to the equipment installation and able to render service to the equipment on a regular and emergency basis during the warranty period of the contract.
- D. Manufacturer's Recommendations: Where installation procedures are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendation shall be cause for rejection of the equipment or material.

2.02 Nameplates:

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- A. For each piece of electrical equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings, the model designation, and shop order number.
- B. Identify each piece of equipment and related controls with a rigid laminated engraved plastic nameplate. Unless otherwise noted, nameplates shall be melamine plastic 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 0.5 by 2.5 inches unless otherwise noted. Where not otherwise specified, lettering shall be a minimum of 0.25 inch high normal block style. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel or brass screws.

2.03 Fasteners:

- A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel.

2.04 Finish requirements:

- A. Equipment: Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish which has been damaged or is otherwise unsatisfactory, to the satisfaction of the Architect.
- B. Wiring System: In finished areas, paint all exposed conduits, boxes and fittings to match the color of the surface to which they are affixed.

PART 3 - EXECUTION

3.01 Workmanship:

- A. Ensure that all equipment and materials fit properly in their installation.
- B. Perform any required work to correct improperly fit installation at no additional expense to the owner.
- C. All electrical equipment and materials shall be installed in a neat and workmanship manner in accordance with the "NECA-1 Standard Practices for Good Workmanship in Electrical Contracting". Workmanship of the entire job shall be first class in every respect.

3.02 Equipment Installations:

- A. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.
- B. Do all the cutting and patching necessary for the proper installation of work and repair any damage done.
- C. Earthquake restraints: all electrical equipment, including conduits over 2 inches in diameter, shall be braced or anchored to resist a horizontal force acting in any direction as per CBC Section 1616A Title 24, part 2, and ASCE7-10, Section 13.3 and 13.6 and Table 13.6-1.
- D. Structural work: All core drilling, bolt anchor insertion, or cutting of existing structural concrete shall be approved by a California registered structural consulting engineer prior to the execution of any construction. At all floor slabs and structural concrete walls to be drilled, cut or bolt anchors inserted, the contractor shall find and mark all reinforcing in both faces located by means of x-ray, pach-ometer, or prof-ometer. Submit sketch showing location of rebar and proposed cuts, cores, or bolt anchor locations for approval.

3.03 Field Test:

- A. Test shall be in accordance with Acceptance testing specifications issued by the National Electrical Testing Association (NETA).
- B. Perform equipment field tests and adjustments. Properly calibrate, adjust and operationally check all circuits and components, and demonstrate as ready for service. Make additional calibration and adjustments if it is determined later that the initial adjustments are not satisfactory for proper performance. Perform equipment field test for equipment where equipment field tests are specified in the equipment Specifications. Give sufficient notice to the Architect prior to any test so that the tests may be witnessed.
- C. Provide instruments, other equipment and material required for the tests. These shall be of the type designed for the type of tests to be performed. Test instrument shall be calibrated by a recognized testing laboratory within three months prior to performing tests.
- D. Operational Tests: Operationally test all circuits to demonstrate that the circuits and equipment have been properly installed and adjusted and are ready for full-time service. Demonstrate the proper functioning of circuits in all modes of operation, including alarm conditions.
- E. Re-testing will be required for all unsatisfactory tests after the equipment or system has been repaired. Re-test all related equipment and systems if required by the Architect. Repair and re-test equipment and systems which have been satisfactorily tested but later fail, until satisfactory performance is obtained.
- F. Maintain records of each test and submit five copies to the Architect when testing is complete. All tests shall be witnessed by the Architect. These records shall include:
 - 1. Name of equipment tested.
 - 2. Date of report.
 - 3. Date of test.
 - 4. Description of test setup.
 - 5. Identification and rating of test equipment.
 - 6. Test results and data.
 - 7. Name of person performing test.
 - 8. Owner or Architect's initials.
- G. Items requiring testing shall be as noted in the additional electrical sections of these specifications.

3.04 Cleaning Equipment:

- A. Thoroughly clean all soiled surfaces of installed equipment and materials.

3.05 Painting of Equipment:

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- A. Factory Applied: Electrical equipment shall have factory applied painting system which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical section.
- B. Field Applied: Paint electrical equipment as required to match finish of adjacent surfaces.

3.06 Records:

- A. Maintain one copy of the contract Drawing Sheets on the site of the work for recording the "as built" condition. After completion of the work, the Contractor shall carefully mark the work as actually constructed, revising, deleting and adding to the Drawing Sheets as required. The following requirements shall be complied with:
 - 1. Cable Size and Type: Provide the size and type of each cable installed on project.
 - 2. Substructure: Where the location of all underground conduits, pull boxes, stub ups and etc. where are found to different than shown, carefully mark the correct location on the Drawings. Work shall be dimensioned from existing improvements.
 - 3. Size of all conduit runs.
 - 4. Routes of concealed conduit runs and conduit runs below grade.
 - 5. Homerun points of all branch circuit.
 - 6. Location of all switchgear, panels, MCC, lighting control panels, pullcans, etc.
 - 7. Changes made as a result of all approved change orders, addendums, or field authorized revisions.
 - 8. As Builts: At the completion of the Work the Contractor shall review, certify, correct and turn over the marked up Drawings to the Architect for his use in preparing "as built" plans.
 - 9. As built Drawings shall be delivered to the Architect within ten (10) days of completion of construction.

3.07 Clean Up:

- A. Upon completion of electrical work, remove all surplus materials, rubbish, and debris that accumulated during the construction work. Leave the entire area neat, clean, and acceptable to the Architect.

3.08 Mechanical and Plumbing Electrical Work:

- A. The requirements for electrical power and/or devices for all mechanical and plumbing equipment supplied and/or installed under this Contract shall be coordinated and verified with the following:
 - 1. Mechanical and Plumbing Drawings.
 - 2. Mechanical and Plumbing sections of these Specifications.
 - 3. Manufacturers of the Mechanical and Plumbing equipment supplied.
- B. The coordination and verification shall include the voltage, ampacity, phase, location and type of disconnect, control, and connection required. Any changes that are required as a result of this coordination and verification shall be a part of this Contract.

- C. The Electrical Contractor shall furnish and install the following for all mechanical and plumbing equipment:
1. Line voltage conduit and wiring.
 2. Disconnect switches.
 3. Manual line motor starters.
- D. Automatic line voltage controls and magnetic starters shall be furnished by the Mechanical and/or Plumbing Contractor and installed and connected by the Electrical Contractor. When subcontracted for by the Mechanical and/or Plumbing Contractor, all line voltage control wiring installed by the Electrical Contractor shall be done per directions from the Mechanical and/or Plumbing Contractor.
- E. All low voltage control wiring for Mechanical and Plumbing equipment shall be installed in conduit. Furnishing, installation and connection of all low voltage conduit, boxes, wiring and controls shall be by the Mechanical and/or Plumbing Contractor.
- F. Disconnects (Motor And Circuit)
1. Disconnect switches shall be as manufactured by ITE- Siemens, General Electric or Square D.
- G. Disconnects (Motor: Fused):
1. Disconnect switches shall be provided and located at all motors.
 2. Switches for three-phase motors shall be heavy-duty, horsepower rated three-pole, and surface mounted except as noted on drawings.
 3. Switches containing more than three poles shall be as specified on the drawings.
 4. Switches for single-phase, fractional horsepower motors shall be heavy-duty, horsepower rated.
 5. Switches shall be horsepower rated.
- H. Manual motor starters, where required, shall have toggle type operators with pilot light and melting alloy type overload relays, SQUARE D COMPANY, Class 2510, Type FG-1P (surface) or Type FS-1P (flush) or ITE, WESTINGHOUSE or GENERAL ELECTRIC equal.

END OF SECTION

SECTION 260519

LINE VOLTAGE WIRE AND CABLE

PART 1 - GENERAL

1.01 Description of Work:

- A. The work of this Section consists of providing all wire and cable rated 600 volts or less, including splices and terminations, as shown on the Drawings and as described herein.

1.02 Related Work:

- A. See the following Specification Section for work related to the work in this Section:
 - 1. 260542 Conduits, Raceways and Fittings.
 - 2. 260533 Junction and Pull Boxes.

1.03 Quality Assurance

- A. Field tests shall be performed as specified in paragraph 3.04 of this Section.

PART 2 - PRODUCTS

2.01 Conductors:

- A. Conductors shall be copper, type THHN/THWN/MTW oil and gasoline resistant, 600 volt rated insulation.
- B. Conductors shall be stranded copper.
- C. Minimum power and control wire size shall be No. 12 AWG unless otherwise noted.
- D. All conductors used on this Project shall be of the same type and conductor material.

2.02 Cables:

- A. All individual conductors shall be copper with type THHN/THWN, 600 volt rated insulation.
- D. Insulation Marking - All insulated conductors shall be identified with printing colored to contrast with the insulation color.
- E. Color Coding - As specified in paragraph 3.03.
- F. Special Wiring - Where special wiring is proposed by an equipment manufacturer, submit the special wiring requirements to the Owner's Representative and, if approved, provide same. Special wire shall be the type required by the equipment manufacturer.
- G. Other Wiring - Wire or cable not specifically shown on the Drawings or specified, but required, shall be of the type and size required for the application and as approved by the Owner's Representative.
- H. Manufacturer - Acceptable manufacturers including Cablec, Southwire, or equal.

2.03 Terminations:

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- A. Manufacturer - Terminals as manufactured by T&B, Burndy or equal.
- B. Wire Terminations – Stranded conductors shall be terminated in clamping type terminations which serve to contain all the strands of the conductor. Curling of a stranded conductor around a screw type terminal is not allowed. For screw type terminations, use a fork type stake-on termination on the stranded conductor. Use only a stake-on tool approved for the fork terminals selected.
- C. End Seals - Heat shrink plastic caps of proper size for the wire on which used.

2.04 Tape:

- A. Tape used for terminations and cable marking shall be compatible with the insulation and jacket of the cable and shall be of plastic material.

PART 3 - EXECUTION

3.01 Cable Installation:

- A. Clean Raceways - Clean all raceways prior to installation of cables as specified in Section 260542 - Conduits Raceway and Fittings.
- B. All line voltage wiring shall be installed in conduit.
- C. All feeder conductors shall be continuous from equipment to equipment. Splices in feeders are not permitted unless specifically noted or approved by the Electrical Engineer.
- D. All branch circuit wiring shall be run concealed in ceiling spaces, walls, below floors or in crawl spaces unless noted otherwise.
- E. Cable Pulling - Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Only soapstone, talc, or UL listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables and exercise care in pulling, to avoid damage to conductors.
- F. Bending Radius - Cable bending radius shall be per applicable code. Install feeder cables in one continuous length.
- G. Equipment Grounding Conductors - Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in all conduits or all raceways.
- H. Panelboard Wiring - In panels, bundle incoming wire and cables which are No. 6 AWG and smaller, lace at intervals not greater than 6 inches, neatly spread into trees and connect to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Perform lacing with plastic cable ties or linen lacing twine. Where plastic panel wiring duct is provided for cable runs, lacing is not necessary when the cable is properly installed in the duct.

3.02 Cable Terminations and Splices:

- A. Splices - UL Listed wirenuts.
- B. Terminations - Shall comply with the following:
 - 1. Make up and form cable and orient terminals to minimize cable strain and stress on device being terminated on.

2. Burnish oxide from conductor prior to inserting in oxide breaking compound filled terminal.

3.03 Circuit and Conductor Identification:

A. Color Coding - Provide color coding for all circuit conductors. Insulation color shall be white for neutrals and green for grounding conductors. Conductor colors shall be as follows:

<u>VOLTAGE</u>	<u>208/120V</u>	<u>480/277V</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Grey
Ground	Green	Green

B. Color coding shall be in the conductor insulation for all conductors #10 AWG and smaller; for larger conductors, color shall be either in the insulation or in colored plastic tape applied at every location where the conductor is readily accessible.

C. Circuit Identification - All underground distribution and service circuits shall be provided with plastic identification tags in each secondary box and at each termination. Tags shall identify the source transformer of the circuit and the building number(s) serviced by the circuit.

3.04 Field Tests:

A. All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than the requirements of the CEC. All circuits shall be tested for proper neutral connections.

B. Insulation Resistance Tests: Perform insulation resistance tests on circuits with #2 AWG and larger conductors to be energized with a line-to-neutral voltage of 120 volts or more. Make these tests before all equipment has been connected. Test the insulation with a 500Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 2 megohms or more. Submit results for review.

END OF SECTION

SECTION 260526

GROUNDING

PART 1 GENERAL

1.01 Section Includes:

- A. Conduits, wires, ground rods and other materials for the electrical grounding system.

1.02 Related Sections:

- A. Section 260500 - Electrical General Requirements.

PART 2 PRODUCTS

2.01 Ground Rod:

- A. "Copperweld" ground rod conforming to or exceeding requirements of U.L. Specification No. 467 (ANSI C-33.8). Rod shall be 3/4" diameter and 10' in length, unless otherwise noted on the Drawings.

2.02 Below Grade Connections:

- A. Compression fittings, Thomas & Betts, Series 52000, 53000 or 54000 or approved equal.

2.03 Hardware:

- A. Bolts, nuts and washers shall be bronze, cadmium plated steel or other non-corrosive materials, approved for the purpose.

2.04 Waterproof Sealant:

- A. Use Kearney "Aqua Seal" mastic sealant on all below grade clamp or compression type connections.

PART 3 EXECUTION

3.01 Grounding and Bonding:

- A. Grounding and bonding shall be as required by codes and local authorities.
- B. All electrical equipment shall be grounded, including, but not limited to, panel boards, terminal cabinets and outlet boxes.
- C. The ground pole of receptacles shall be connected to their outlet boxes by means of a copper ground wire connecting to a screw in the back of the box.
- D. A green insulated copper ground wire, sized to comply with codes, shall be installed in all conduit runs.
- E. All metal parts of pull boxes shall be grounded per code requirements.
- F. All ground conductors shall be green insulated copper.

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- G. The ground system electrodes shall be tested for resistance before the equipment ground conductors are connected. Maximum ground system resistance shall be 25 ohms. Install up to two additional ground rods to meet the 25 ohm requirement. Multiple ground rods shall not be less than 10 feet apart.

- H. Grounding of the panels and relocatables shall be completed as indicated on the Drawings.

END OF SECTION

SECTION 260533

OUTLET, JUNCTION AND PULL BOXES

PART 1 - GENERAL

1.01 Description of Work:

- A. The work of this Section consists of providing all required labor, supervision, materials and equipment to satisfactorily complete all electrical installations shown on the drawings, included in these Specification, or otherwise needed for a complete and fully operating facility. The work shall include but not be limited to the following:
- B. Furnish and install all required material, supports and miscellaneous material for the satisfactory interconnection of all associated electrical systems.

1.02 Related Work:

- A. See the following specification sections for work related to the work of this section.
 - 1. 260500 General Electrical Requirements.
 - 2. 260542 Conduits, Raceway and Fittings.
 - 3. 260519 Line Voltage Wire and Cable.

PART 2 - PRODUCTS

2.01 Outlet boxes, Junction and Pull boxes

- A. Standard Outlet Boxes: Galvanized, steel, knock-out type of size and configuration best suited to the application indicated on the Drawings. Minimum box size shall be 4 inches square (octagon for most light fixtures) by 1-1/2 inches deep with mud rings as required.
- B. Switch boxes: Minimum box size shall be 4 inches square by 1-1/2 inches deep with mud rings as required. Install multiple switches in standard gang boxes with raised device covers suitable for the application indicated.
- C. Conduit bodies: Cadmium plated, cast iron alloy. Conduit bodies with threaded conduit hubs and neoprene gasketed, cast iron covers. Bodies shall be used to facilitate pulling of conductors or to make changes in conduit direction only. Splices are not permitted in conduit bodies. Crouse-Hinds Form 8 Condulets, Appleton Form 35 Unilets or equal.
- D. Sheet Metal Boxes: Use standard outlet or concrete ring boxes wherever possible; otherwise use a minimum 16 gauge galvanized sheet metal, NEMA I box sized to Code requirements with covers secured by cadmium plated machine screws located six inches on centers. Circle AW Products, Hoffman Engineering Company or equal.
- E. Flush Mounted Pull boxes and Junction boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

PART 3 - EXECUTION

3.01 Outlet Boxes

A. General:

1. All outlet boxes shall finish flush with building walls, ceilings and floors except in mechanical and electrical rooms above accessible ceiling or where exposed work is called for on the Drawings.
2. Install raised device covers (plaster rings) on all switch and receptacle outlet boxes installed in masonry or stud walls or in furred, suspended or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
3. Leave no unused openings in any box. Install close-up plugs as required to seal openings.

B. Box Layout:

1. Outlet boxes shall be installed at the locations and elevations shown on the drawings or specified herein. Make adjustments to locations as required by structural conditions and to suit coordination requirements of other trades.
2. Locate switch outlet boxes on the latch side of doorways.
3. Outlet boxes shall not be installed back to back nor shall through-wall boxes be permitted. Outlet boxes on opposite sides of a common wall shall be separated horizontally by at least one stud or vertical structural member.
4. For outlets mounted above counters, benches or backsplashes, coordinate location and mounting heights with built-in units. Adjust mounting height to agree with required location for equipment served.
5. On fire rated walls, the total face area of the outlet boxes shall not exceed 100 square inches per 100 square feet of wall area.

C. Supports:

1. Outlet Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on specified box supports.
2. Fixture outlet boxes installed in suspended ceiling of gypsum board or lath and plaster construction shall be mounted to 16 gauge metal channel bars attached to main ceiling runners.
3. Fixture outlet boxes installed in suspended ceilings supporting acoustical tiles or panels shall be supported directly from the structure above where pendant mounted lighting fixture are to be installed on the box.
4. Fixture Boxes above tile ceilings having exposed suspension systems shall be supported directly from the structure above.
5. Outlet and / or junction boxes shall not be supported by grid or fixture hanger wires at any locations.

3.02 Junction and Pull Boxes

A. General:

1. Install junction or pull boxes where required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that these boxes are not shown on the Drawings.
2. Locate pull boxes and junction boxes in concealed locations above accessible ceilings or exposed in electrical rooms, utility rooms or storage areas.
3. Install raised covers (plaster rings) on boxes in stud walls or in furred, suspended or exposed concrete ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
4. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
5. Identify circuit numbers and panel on cover of junction box with black marker pen.

B. Box Layouts:

1. Boxes above hung ceilings having concealed suspension systems shall be located adjacent to openings for removable recessed lighting fixtures.

C. Supports:

1. Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on specified box supports.
2. Boxes installed in suspended ceilings of gypsum board or lath and plaster construction shall be mounted to 16 gauge metal channel bars attached to main ceiling runners.
3. Boxes installed in suspended ceilings supporting acoustical tiles or panels shall be supported directly from the structure above.
4. Boxes mounted above suspended acoustical tile ceilings having exposed suspension systems shall be supported directly from the structure above.

END OF SECTION

SECTION 260542

CONDUITS, RACEWAYS AND FITTINGS

PART 1 - GENERAL

1.01 Description of Work:

- A. The work of this section consists of furnishing and installing conduits, raceways and fittings as shown on the Drawings and as described herein.

1.02 Related Work:

- A. See the following specification sections for work related to the work in this section:
 - 1. 260543 Underground Ducts
 - 2. 260544 In Grade Pull Boxes
 - 3. 260519 Line Voltage Wire and Cable
 - 4. 260533 Junction and Pull Boxes

PART 2 - PRODUCTS

2.01 Conduits, Raceways:

- A. Electrical Metallic Tubing (EMT) shall be hot-dip galvanized after fabrication. Couplings shall be compression or set-screw type.
- B. Flexible Conduit: Flexible metal conduit shall be galvanized steel.
- C. Galvanized Rigid Steel Conduit (GRS) shall be hot-dip galvanized after fabrication. Couplings shall be threaded type.
- D. Rigid Non-metallic Conduit: Rigid non-metallic conduit shall be PVC Schedule 40 (PVC-40 or NEMA Type EPC-40) conduit approved for underground use and for use with 90° C wires.

2.02 Conduit Supports:

- A. Supports for individual conduits shall be galvanized malleable iron one-hole type with conduit back spacer.
- B. Supports for multiple conduits shall be hot-dipped galvanized Unistrut or Superstrut channels, or approved equal. All associated hardware shall be hot-dip galvanized.
- C. Supports for EMT conduits shall be galvanized pressed steel single hole straps.
- D. Clamp fasteners shall be by wedge anchors. Shot in anchors shall not be allowed.

2.03 Fittings:

- A. Provide threaded-type couplings and connectors for rigid steel conduits; provide steel compression (watertight), or steel set-screw type for EMT, (die-cast zinc or malleable iron type fittings are not allowed). Provide threaded couplings and Meyers hubs for rigid steel conduit exposed to weather.

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- B. Fittings for flexible conduit shall be Appleton, Chicago, IL, Type ST, O-Z Gedney Series 4Q by General Signal Corp., Terryville, CT, T & B 5300 series, or approved equal.
- C. Fittings for use with rigid steel shall be galvanized steel or galvanized cast ferrous metal; access fittings shall have gasketed cast covers and be Crouse Hinds Condulets, Syracuse, NY, Appleton Unilets, Chicago, IL, or approved equal. Provide threaded-type couplings and connectors; set-screw type and compression-type are not acceptable.
- D. Fittings for use with rigid non-metallic conduit shall be PVC and have solvent-weld-type conduit connections.
- E. Union couplings for conduits shall be the Erickson type and shall be Appleton, Chicago, IL, Type EC, O-Z Gedney 3-piece Series 4 by General Signal Corp., Terryville, CT, or approved equal. Threadless coupling shall not be used.
- F. Bushings:
 - 1. Bushings shall be the insulated type.
 - 2. Bushings for rigid steel shall be insulated grounding type, O-Z Gedney Type HBLG, Appleton Type GIB, or approved equal.
- G. Conduit Sealants:
 - 1. Fire Retardant Types: Fire stop material shall be reusable, non-toxic, asbestos-free, expanding, putty type material with a 3-hour rating in accordance with UL Classification 35L4 or as specified on the Drawings.

PART 3 - EXECUTION

3.01 Conduit, Raceway and Fitting Installation:

- A. For conduit runs exposed to weather provide rigid metal (GRS).
- B. For conduit run underground, in concrete or masonry block wall and under concrete slabs, install minimum ¾" size nonmetallic (PVC) with PVC elbows. Where conduits transition from underground or under slab to above grade install wrapped rigid metal (GRS) elbows and risers.
- C. For conduit runs concealed in steel or wood framed walls or in ceiling spaces or exposed in interior spaces above six feet over the finished floor, install EMT.
- D. Flexible metal conduit shall be used only for the connection of recessed lighting fixtures and motor connections unless otherwise noted on the Drawings. Liquid-tight steel flexible conduit shall be used for motor connections.
- E. The minimum size raceway shall be 1/2-inch unless indicated otherwise on the Drawings.
- F. Installation shall comply with the CEC.
- G. From pull point to pull point, the sum of the angles of all of the bends and offset shall not exceed 360 degrees.
- H. Conduit Supports: Properly support all conduits as required by the NEC. Run all conduits concealed except where otherwise shown on the drawings.
 - 1. Exposed Conduits: Support exposed conduits within three feet of any equipment or device and at intervals not exceeding NEC requirements; wherever possible, group conduits

together and support on common supports. Support exposed conduits fastened to the surface of the concrete structure by one-hole clamps, or with channels. Use conduit spacers with one-hole clamps.

- a. Conduits attached to walls or columns shall be as unobtrusive as possible and shall avoid windows. Run all exposed conduits parallel or at right angles to building lines.
 - b. Group exposed conduits together. Arrange such conduits uniformly and neatly.
2. Support all conduits within three feet of any junction box, coupling, bend or fixture.
 3. Support conduit risers in shafts with Unistrut Superstrut, or approved equal, channels and straps.
- I. Moisture Seals: Provide in accordance with NEC paragraphs 230-8 and 300-5(g).
 - J. Where PVC conduit transitions from underground to above grade, provide rigid steel 90's with risers. Rigid steel shall be half-lap wrapped with 20 mil tape and extend minimum 12" above grade.
 - K. Provide a nylon pull cord in each empty raceway.
 - L. Provide galvanized rigid steel factory fittings for galvanized rigid steel conduit.
 - M. Slope all underground raceways to provide drainage; for example, slope conduit from equipment located inside a building to the pull box or manhole located outside the building.
 - N. Conduits shall be blown out and swabbed prior to pulling wires, or installation of pull cord in empty conduits.

END OF SECTION

SECTION 260543

UNDERGROUND DUCTS

PART 1 - GENERAL

1.01 Description of Work:

- A. The work of this section consists of furnishing and installing raceways, raceway spacers with necessary excavation.

1.02 Related Work:

- A. See the following specification sections for work related to the work of this section.

1. 02200 Excavation and Backfill
2. 260542 Conduit Raceway and Fittings

1.03 Standards and Codes:

- A. Work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes.

1. National Electrical Code (NEC) (Latest Revision)
2. California Electrical Code (CEC).
3. Underground Installations CEC - Article 300.5
4. Rigid NonMetallic Conduit CEC - Article 347

PART 2 - PRODUCTS

2.01 Raceways:

- A. As specified in Section 260542 Conduits, Raceways and Fittings.

PART 3 - EXECUTION

3.01 Excavation:

- A. As specified in Section 02200, Excavation and Backfill and as required for the work shown on the Drawings.

3.02 Install raceways as indicated on drawings.

3.03 Sand Encasement:

- A. As specified in Section 02200 - Excavation and Backfill.

3.04 Backfill:

- A. As specified in Section 02200 - Excavation and Backfill.

END OF SECTION

SECTION 260544

IN GRADE PULL BOXES

PART 1 - GENERAL

1.01 Description of Work:

- A. The work of this section consists of providing all labor, supervision, tools, materials, and performing all work necessary to furnish and install pre-cast concrete vaults, and pull boxes with necessary excavation.

1.02 Related Work:

- A. See the following specification sections for work related to the work of this section.

- 1. 02200 Excavation and Backfill.
- 2. 260543 Underground Ducts.

1.03 Submittals:

- A. As specified in Section 260500 and Division 01.

- 1. Catalog Data: Provide manufacturer's descriptive literature - Pre-cast Vaults, Pull Boxes and Accessories.

PART 2 - PRODUCTS

2.01 Materials and Equipment:

A. General Requirements:

- 1. Pull boxes for electrical power, controls and other communication circuits shall consist of pre-cast reinforced concrete boxes, extensions' bases, and covers as specified herein and as indicated on the Drawings. Pre-cast units shall be the product of a manufacturer regularly engaged in the manufacture of pre-cast vaults and pull boxes. Acceptable manufacturers are Christy, Utility Vault, Brooks, Associated Concrete or equal.

B. Construction:

- 1. Pre-cast concrete vaults and pull boxes for electrical power distribution and communication circuits with associated risers and tops shall conform to ASTM C478 and ACI 318. Pull boxes shall be the type noted on the Drawings and shall be constructed in accordance with the applicable details as shown. Tops and walls shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Duct entrances and windows shall be located near the corners of structures to facilitate cable racking.

C. Covers:

- 1. The word "ELECTRICAL" shall be cast in the top face of all electrical cable boxes. The word "Signal" or "Fire Alarm" shall be cast in the top of the boxes utilized for these systems.

PART 3 - EXECUTION

3.01 Installation:

- A. Install pull boxes where required to limit bends in conduit runs to not more than 360 degrees or where pulling tension achieved would exceed the maximum allowable for the cable to be installed. Note that these boxes are not shown on the Drawings.
- B. Pre-cast pull boxes shall be installed approximately where indicated on the Drawings. The exact location of each pull box shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. All cable boxes and secondary pull boxes shall be installed with a minimum of 6-inch thick crushed rock or sand bedding.
- C. Paved areas - Vaults and pull boxes located in areas to be paved shall be installed such that the top of the cover shall be flush with the finished surface of the paving.
- D. Unpaved Areas - In unpaved areas, the top of vaults and pull box covers shall be approximately 2 inches above finished grade.
- E. Joint Seals - Section joints of pre-cast vaults and pull boxes shall be sealed with compound as recommended by the manufacturer.
- F. Trenching, Backfilling, and Compaction - Trenching, backfilling and compaction shall be as specified in Section 02200 - Excavation and Backfill.

END OF SECTION

SECTION 260550

THROUGH-PENETRATION FIRESTOPPING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 Related Documents:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Section, apply to work specified in this section.

1.2 Definitions:

- A. Firestopping: The process of restoring an hourly fire endurance rating back to a fire barrier that lost its rating from an opening created in it.

1.3 General Description of the Work of This Section:

Only tested firestop systems shall be used in specific locations as follows:

- A. Penetrations for the passage of cables, conduit, and other electrical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

1.4 Related Work of Other Sections:

- A. Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including (if available):
 - 1. Section 03300 - Cast-In-Place Concrete
 - 2. Section 04200 - Masonry Work
 - 3. Section 07840 - Firestopping
 - 4. Section 09250 - Gypsum Drywall Systems
 - 5. Section 13080 - Sound, Vibration and Seismic Control
 - 6. Section 13900 - Fire Suppression and Supervisory Systems
 - 7. Section 16000 - [26 05 00] – General Electrical Requirements
 - 8. Section 15300 - Fire Protection

1.5 References:

- A. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops" (July 1997).
- B. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
 - 1. UL Fire Resistance Directory:
 - a. Through-Penetration Firestop Devices (XHCR)
 - b. Fire Resistance Ratings (BXUV)
 - c. Through-Penetration Firestop Systems (XHEZ)
 - d. Fill, Voids, or Cavity Material (XHHW)
 - e. Forming Materials (XHKU)

- C. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments

- D. ASTM E-84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. All major building codes: ICBO, SBCCI, BOCA, and IBC.
(Note to specifier: Retain or delete building codes listed above as applicable)
- F. NFPA 101 - Life Safety Code

1.6 Quality Assurance:

- A. Firestop System installation must meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- B. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- C. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

1.7 Project Conditions :

- A. Do not use materials that contain flammable solvents.
- B. Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- C. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.
- D. Scheduling
 - 1. Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
 - 2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- E. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- F. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 - PRODUCTS

2.1 Firestopping, General:

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

- C. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur.

2.2 Acceptable Manufacturers:

- A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
 1. Specified Technologies Inc., STI
800-992-1180
 2. Hilti, Inc., Tulsa, Oklahoma
800-879-8000
 3. Other manufacturers listed in the U.L. Fire Resistance Directory – Volume 2

2.3 Materials:

- A. Use only firestop products that have been UL 1479, ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Cast-in place firestop devices: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket. Cast-in Place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems), or electrical cable bundles, penetrating concrete floors, the following products are acceptable:
 1. Specified Technologies, Inc. (STI) SpecSeal CD Cast-In Firestop Device
 2. Hilti CP 680 Cast-In Place Firestop Device
 3. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- C. Latex Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture. Latex Sealants for use with non-combustible items including rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
 1. Specified Technologies, Inc. (STI) SpecSeal Series SSS Intumescent Sealant
 2. Specified Technologies, Inc. (STI) SpecSeal Series LCI Intumescent Sealant
 3. Specified Technologies, Inc. (STI) SpecSeal Series LC Endothermic Sealant
 4. Hilti FS-ONE Intumescent Firestop Sealant
 5. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- D. Intumescent Latex sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture. Intumescent Latex Sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
 1. Specified Technologies, Inc. (STI) SpecSeal Series SSS Intumescent Sealant
 2. Specified Technologies, Inc. (STI) SpecSeal Series LCI Intumescent Sealant
 3. Hilti FS-ONE Intumescent Firestop Sealant
 4. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- E. Intumescent sealants, foams, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
 1. Specified Technologies, Inc. (STI) SpecSeal Series SSS Intumescent Sealant
 2. Specified Technologies, Inc. (STI) SpecSeal Series LCI Intumescent Sealant
 3. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty

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4. Specified Technologies, Inc. (STI) Ready Firestop Grommet
 5. Hilti FS-ONE Intumescent Firestop Sealant
 6. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- F. Non curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
1. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty
 2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- G. Wall opening protective materials: Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes to reduce horizontal separation to less than 24". Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
1. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty Pads
 2. Specified Technologies, Inc. (STI) SpecSeal Series EP PowerShield Insert Pads
 3. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 1
- H. Materials used for complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Specified Technologies, Inc. (STI) SpecSeal Series SSM Firestop Mortar
 2. Specified Technologies, Inc. (STI) SpecSeal Series SSB Firestop Pillows
 3. Hilti FS 635 Trowelable Firestop Compound
 4. Hilti FS 657 FIRE BLOCK
 5. Hilti CP 620 Fire Foam
 6. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- I. Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Specified Technologies, Inc. (STI) SpecSeal Series SSB Firestop Pillows
 2. Hilti FS 657 FIRE BLOCK
 3. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- J. Fire Rated Cable Pathways: STI EZ-PATH™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
1. Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway
- K. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.

PART 3 - EXECUTION

3.1 Preparation:

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
1. Verify penetrations are properly sized and in suitable condition for application of materials.

2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
5. Do not proceed until unsatisfactory conditions have been corrected.

3.2 Coordination:

- A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.

3.3 Installation:

- A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration materials.
 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
 2. Protect materials from damage on surfaces subjected to traffic.

3.4 Field Quality Control:

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 Adjusting and Cleaning:

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION

SECTION 260923

DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

PART 1 – GENERAL

1.01 Summary:

A. Section Includes:

1. Digital Lighting Controls
2. Relay Panels
3. Emergency Lighting Control (if applicable)

B. Related Sections:

1. Section 262726 - Wiring Devices: Receptacles
2. Section 265100 –Lighting
3. [Section [250000 – Integrated Automation] Building integrator shall provide integration of the lighting control system with Building Automation Systems.]
4. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01, Specification Sections apply to this Section
5. Electrical Sections, including wiring devices, apply to the work of this Section.

C. Control Intent – Control Intent includes, but is not limited to:

1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
2. Initial sensor and switching zones
3. Initial time switch settings
4. Task lighting and receptacle controls
5. Emergency Lighting control (if applicable)

1.02 References:

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
- B. National Electrical Manufacturers Association (NEMA)
- C. Underwriters Laboratories, Inc. (UL)
 1. 20 – Plug Load Controls
 2. 508– Industrial Controls

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3. 916 – Energy Management Equipment.
4. 924 – Emergency Lighting

1.03 System Description & Operation:

- A. The Lighting Control and Automation system as defined under this section covers the following equipment:
1. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
 2. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
 3. Handheld remotes for personal control – One-button dimming, two-button on/off, or five-button scene remotes provide control using infrared communications. Remote may be configured in the field to control selected loads or scenes without special tools.
 4. Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications can provide switching, bi-level, tri-level or dimming control for daylight harvesting.
 5. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
 6. Digital Plug-Load Controllers – Self-configuring, digitally addressable, single relay, plenum-rated application-specific controllers. Selected models include integral current monitoring capabilities.
 7. Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow bi-directional communication of room variables and occupancy sensor settings. Computer software also customizes room settings.
 8. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
 9. Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded,) to connect multiple DLM local networks for centralized control
 10. Network Bridge – provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.
 11. Segment Manager – provides web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
 12. Programming and Configuration software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.
 13. LMCP Digital Lighting Management Relay Panel – provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy

installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS).

14. Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

1.04 Lighting Control Applications:

- A. Unless relevant provisions of the applicable local Energy Codes are more stringent, provide a minimum application of lighting controls as follows:

1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.
2. Bi-Level Lighting – Provide multi-level controls in all spaces except toilet rooms, storerooms, library stacks, or applications where variable dimming is used.
3. Task Lighting / Plug Loads – Provide automatic shut off of non-essential plug loads and task lighting in all spaces except toilet rooms and storerooms. Provide Automatic-ON of plug loads whenever spaces are occupied. For spaces with multiple occupants a single shut off consistent with the overhead lighting may be used for the area.
4. Daylit Areas – Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:
 - a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
 - b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
 - c. Multiple-leveled switched daylight harvesting controls may be utilized for areas marked on drawings.
 - d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.
5. Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four (4) pre-set lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to extinguish all lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

1.05 Submittals:

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A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.

B. Shop Drawings:

1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
2. Show exact location of all digital devices and part numbers, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans.)
3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:

1. Indicates where sensor is proposed to be installed.
2. Prove that the sensor is suitable for the proposed application.

1.06 Quality Assurance:

A. Manufacturer: Minimum [10] years experience in manufacture of lighting controls.

1.07 Project Conditions:

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 0° to 40° C (32° to 104° F).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.08 Warranty:

A. Provide a five year limited manufacturer's warranty on all room control devices and panels.

1.09 Maintenance:

A. Spare Parts:

1. Provide spares of each product to be used for maintenance as listed below:
 - a. Provide one of each type of room controller, switch, plug load controller and sensor on the project.

PART 2 – PRODUCTS

2.01 Manufacturers:

A. Acceptable Manufacturer:

1. WattStopper
 - a. System: Digital Lighting Management (DLM)
2. Basis of design product: WattStopper Digital Lighting Management (DLM) or subject to compliance and prior approval with specified requirements of this section, of the following:
 - a. Approved equal.

B. Substitutions:

1. This specification is based on products from WattStopper, Santa Clara, CA. Complete information on any other system proposed as a substitute must be submitted in writing for approval after bid and assorted cost saving. Prior approval does not guarantee final approval by the electrical engineer. The contractor shall be completely responsible for providing a system meeting this specification in its entirety. All deviations from this specification must be listed and individually signed off by the consultant.

2.02 Digital Lighting Controls:

- A. Furnish the Company's system which accommodates the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories which suit the lighting and electrical system parameters.

2.03 Digital Wall Switch Occupancy Sensors:

- A. Wallbox mounted passive infrared PIR or dual technology (passive infrared and ultrasonic) digital occupancy sensor with 1 or 2 switch buttons.
- B. Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation. Features include the following:
 1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 2. Programmable control functionality including:
 - a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.

- d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - (1) Ultrasonic and Passive Infrared
 - (2) Ultrasonic or Passive Infrared
 - (3) Ultrasonic only
 - (4) Passive Infrared only
 3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
 4. Two RJ-45 ports for connection to DLM local network.
 5. Two-way infrared (IR) transceiver to allow remote programming through handheld configuration tool and control by remote personal controls.
 6. Device Status LEDs including:
 - a. PIR detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
 7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
 8. Assignment of local buttons to specific loads within the room without wiring or special tools
 9. Manual override of controlled loads..
 10. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.
- C. BACnet object information shall be available for the following objects:
1. Detection state
 2. Occupancy sensor time delay
 3. Occupancy sensor sensitivity, PIR and Ultrasonic
 4. Button state
 5. Switch lock control
 6. Switch lock status
- D. Units shall not have any dip switches or potentiometers for field settings.

- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- F. Two-button wall switch occupancy sensors, when connected to a single relay dimming room controller, shall operate in the following sequence as a factory default:
 - 1. Left button
 - a. Press and release - Turn load on
 - b. Press and hold - Raise dimming load
 - 2. Right button
 - a. Press and release - Turn load off
 - b. Press and hold - Lower dimming load
- G. Low voltage momentary pushbuttons shall include the following features:
 - 1. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 - 2. The following button attributes may be changed or selected using a wireless configuration tool:
 - a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 - b. Individual button function may be configured to Toggle, On only or Off only.
 - c. Individual scenes may be locked to prevent unauthorized change.
 - d. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 - e. Ramp rate may be adjusted for each dimmer switch.
 - f. Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
- H. WattStopper part numbers: LMPW, LMDW. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening. Contractor shall coordinate device finish with [Architect] [Owner].

2.04 Digital Wall or Ceiling Mounted Occupancy Sensor:

- A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor.

- B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 2. Programmable control functionality including:
 - a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
 - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - (1) Ultrasonic and Passive Infrared
 - (2) Ultrasonic or Passive Infrared
 - (3) Ultrasonic only
 - (4) Passive Infrared only
 3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
 4. One or two RJ-45 port(s) for connection to DLM local network.
 5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
 6. Device Status LEDs, which may be disabled for selected applications, including:
 - a. PIR detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding

7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
 8. Manual override of controlled loads.
 9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.
- C. BACnet object information shall be available for the following objects:
1. Detection state
 2. Occupancy sensor time delay
 3. Occupancy sensor sensitivity, PIR and Ultrasonic
- D. Units shall not have any dip switches or potentiometers for field settings.
- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- F. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.05 Digital Wall Switches:

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:
1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 3. Configuration LED on each switch that blinks to indicate data transmission.
 4. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
 6. Programmable control functionality including:
 - a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
 - b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.

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7. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
- B. BACnet object information shall be available for the following objects:
 1. Button state
 2. Switch lock control
 3. Switch lock status
 - C. Two RJ-45 ports for connection to DLM local network.
 - D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.
 - E. The following switch attributes may be changed or selected using a wireless configuration tool:
 1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 2. Individual button function may be configured to Toggle, On only or Off only.
 3. Individual scenes may be locked to prevent unauthorized change.
 4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 5. Ramp rate may be adjusted for each dimmer switch.
 6. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.
 - F. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening. Contractor shall coordinate device finish with [Architect] [Owner].

2.06 Handheld Remote Controls:

- A. Battery-operated handheld devices in 1, 2 and 5 button configurations for remote switching or dimming control. Remote controls shall include the following features:
 1. Two-way infrared (IR) transceiver for line of sight communication with DLM local network within up to 30 feet.
 2. LED on each button confirms button press.
 3. Load buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.
 4. Inactivity timeout to save battery life.
- B. A wall mount holster and mounting hardware shall be included with each remote control

C. WattStopper part numbers: LMRH-101, LMRH-102, LMRH-105.

2.07 Digital Partition Controls:

- A. Partition controls shall enable manual or automatic coordination of lighting controls in flexible spaces with up to four moveable walls by reconfiguring the connected digital switches and occupancy sensors.
- B. Four-button low voltage pushbutton switch for manual control.
 - 1. Two-way infrared (IR) transceiver for use with configuration remote control.
 - 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 - 3. Configuration LED on each switch that blinks to indicate data transmission.
 - 4. Each button represents one wall; Green button LED indicates status.
 - 5. Two RJ-45 ports for connection to DLM local network.
 - 6. WattStopper part number: LMPS-104. Available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening.
- C. Contact closure interface for automatic control via input from limit switches on movable walls (by others).
 - 1. Operates on Class 2 power supplied by DLM local network.
 - 2. Includes 24VDC output and four input terminals for maintained third party contract closure inputs.
 - a. Input max. sink/source current: 1-5mA
 - b. Logic input signal voltage High: >18VDC
 - c. Logic input signal voltage Low: <2VDC
 - 3. Four status LEDs under hinged cover indicate if walls are open or closed; supports LMPS-104 as remote status indicator.
 - 4. Two RJ-45 ports for connection to DLM local network.
 - 5. WattStopper part number: LMIO-102

2.08 Digital Daylighting Sensors:

- A. Digital daylighting sensors shall work with room controllers to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to a room controller. Daylighting sensors shall be interchangeable without the need for rewiring.
 - 1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
 - 2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.

3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.

B. Digital daylighting sensors shall include the following features:

1. The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-6,553 footcandles (fc).
3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.
9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
10. Configuration LED status light on device that blinks to indicate data transmission.
11. Status LED indicates test mode, override mode and load binding.
12. Recessed switch on device to turn controlled load(s) ON and OFF.
13. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
 - a. Light level
 - b. Day and night setpoints
 - c. Off time delay
 - d. On and off setpoints

- e. Up to three zone setpoints
 - f. Operating mode – on/off, bi-level, tri-level or dimming
14. One RJ-45 port for connection to DLM local network.
15. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62" thickness (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62"-1.25" thickness (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
16. Any load or group of loads in the room can be assigned to a daylighting zone
17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
18. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.
- C. Closed loop digital photosensors shall include the following additional features:
- 1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
 - 2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
 - 3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.
 - 4. WattStopper Product Number: LMLS-400, LMLS-400-L.
- D. Open loop digital photosensors shall include the following additional features:
- 1. An internal photodiode that measures light in a 60-degree angle cutting off the unwanted light from the interior of the room.
 - 2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
 - 3. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.
 - 4. WattStopper Product Number: LMLS-500, LMLS-500-L.
- E. Dual loop digital photosensors shall include the following additional features:

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1. Close loop portion of dual loop device must have an internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from sources outside of this con
2. Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60 degree angle, cutting off the unwanted light from the interior of the room.
3. Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load.
4. Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is required.
5. Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes.
6. Device must include extendable mounting arm to properly position sensor within a skylight well.
7. WattStopper product number LMLS-600

2.09 Digital Room Controllers and Plug-load Controllers:

- A. Digital controllers for lighting and plug loads automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room and plug load controllers shall be provided to match the room lighting and plug load control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:
 1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.
 3. Multiple room controllers connected together in a local network must automatically prioritize each room controller, without requiring any configuration or setup, so that loads are sequentially assigned using room controller device ID's from highest to lowest.
 4. Device Status LEDs to indicate:
 - a. Data transmission
 - b. Device has power
 - c. Status for each load
 - d. Configuration status
 5. Quick installation features including:
 - a. Standard junction box mounting

- b. Quick low voltage connections using standard RJ-45 patch cable
6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
 - a. Turn on to 100%
 - b. Remain off
 - c. Turn on to last level
 7. Each load shall be configurable to operate in the following sequences based on occupancy:
 - a. Auto-on/Auto-off (Follow on and off)
 8. Manual-on/Auto-off (Follow off only)
 9. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
 10. BACnet object information shall be available for the following objects:
 - a. Load status
 - b. Electrical current
 - c. Total watts per controller
 - d. Schedule state – normal or after-hours
 - e. Demand response control and cap level
 - f. Room occupancy status
 - g. Total room lighting and plug loads watts
 - h. Total room watts/sq ft
 - i. Force on/off all loads
 11. UL 2043 plenum rated
 12. Manual override and LED indication for each load
 13. Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); 347 volt models rated for 15A total load; plug load controllers carry application-specific UL 20 rating for receptacle control.
 14. Zero cross circuitry for each load
 15. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
- B. On/Off Room Controllers shall include:

1. One or two relay configuration
 2. Efficient 150 mA switching power supply
 3. Three RJ-45 DLM local network ports with integral strain relief and dust cover
 4. WattStopper product numbers: LMRC-101, LMRC-102
- C. On/Off/Dimming enhanced Room Controllers shall include:
1. Real time current monitoring
 2. Multiple relay configurations
 - a. One, two or three relays (LMRC-21x series)
 - b. One or two relays (LMRC-22x series)
 3. Efficient 250 mA switching power supply
 4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
 5. One dimming output per relay
 - a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
 - b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
 - c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
 - d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
 - e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
 - f. Calibration and trim levels must be set per output channel.
 - g. Devices that set calibration or trim levels per controller are not acceptable.
 - h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.
 6. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.

7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
8. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - a. Establish preset level for each load from 0-100%
 - b. Set high and low trim for each load
 - c. Set lamp burn in time for each load up to 100 hours
9. Override button for each load provides the following functions:
 - a. Press and release for on/off control
 - b. Press and hold for dimming control
10. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMRC-221, LMRC-222

D. Plug Load Room Controllers shall include:

1. One relay configuration with additional connection for unswitched load
2. Configurable additive time delay to extend plug load time delay beyond occupancy sensor time delay (e.g. a 10 minute additive delay in a space with a 20 minute occupancy sensor delay ensures that plug loads turn off 30 minutes after the space is vacated).
3. Factory default operation is Auto-on/Auto-off, based on occupancy
4. Real time current monitoring of both switched and un-switched load (LMPL-201 only)
5. Efficient switching power supply
 - a. 150mA (LMPL-101)
 - b. 250mA (LMPL-201)
6. RJ-45 DLM local network ports
 - a. Three RJ-45 ports (LMPL-101)
 - b. Four RJ-45 ports (LMPL-201)
7. WattStopper product numbers: LMPL-101, LMPL-201.

2.10 DLM Local Network (Room Network):

- A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.
- B. Features of the DLM local network include:
 1. Plug n' Go® automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.

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2. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
 3. Push n' Learn® configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
 4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.
- C. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
- D. If manufacturer's pre-terminated Cat 5e cables are not used for the installation, the contractor is responsible for testing each cable following installation and supplying manufacturer with test results.
- E. WattStopper Product Number: LMRJ-Series

2.11 DLM Segment Network (Room to Room Network):

- A. The segment network shall be a linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and LMCP relay panels for centralized control.
1. Each connected DLM local network shall include a single network bridge (LMBC-300), and the network bridge is the only room-based device that is connected to the segment network.
 2. Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate "in" and "out" terminations, for segment network connections.
 3. The segment network shall utilize 1.5 twisted pair, shielded, cable supplied by the lighting control manufacturer. The maximum cable run for each segment is 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pf/ft and have a characteristic impedance of 120 Ohms.
 4. Network signal integrity requires that each conductor and ground wire be correctly terminated at every connected device.
 5. Substitution of manufacturer-supplied cable must be pre-approved: Manufacturer will not certify network reliability, and reserves the right to void warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer's specific requirements.
 6. Segment networks shall be capable of connecting to BACnet-compliant BAS (provided by others) either directly, via MS/TP, or through NB-ROUTERS, via BACnet/IP or BACnet/Ethernet. Systems whose room-connected network infrastructure require gateway devices to provide BACnet data to a BAS are unacceptable.
- B. WattStopper Product Number: LM-MSTP, LM-MSTP-DB

2.12 Configuration Tools:

- A. A wireless configuration tool facilitates optional customization of DLM local networks using two-way infrared communications, while PC software connects to each local network via a USB interface.
- B. Features and functionality of the wireless configuration tool shall include but not be limited to:
 - 1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 - 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
 - 3. Must be able to read and modify parameters for room controllers, occupancy sensors, wall switches, daylighting sensors, network bridges and relay panels, and identify room devices by type and serial number.
 - 4. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
 - 5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
 - 6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
 - 7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
 - 8. Verify status of building level network devices.
- C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.13 Network Bridge:

- A. The network bridge module connects a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver.
 - 1. The network bridge shall be provided as a separate module connected on the local network through an available RJ-45 port.
 - 2. Provide Plug n' Go operation to automatically discover room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network.
 - 3. The network bridge shall automatically create standard BACnet objects for selected room device parameters to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM room devices on each local network. BACnet objects will be created for the addition or replacement of any given in-room DLM device for the installed life of the system. Products requiring that an application-specific point database be loaded to create or map BACnet objects are not acceptable. Systems not capable of providing BACnet data for control devices via a dedicated BACnet Device ID and physical MS/TP termination per room are not acceptable. Standard BACnet objects shall be provided as follows:
 - a. Read/write the normal or after hours schedule state for the room

- b. Read the **detection** state of each occupancy sensor
- c. Read the aggregate occupancy state of the room
- d. Read/write the On/Off state of loads
- e. Read/write the dimmed light level of loads
- f. Read the button states of switches
- g. Read total current in amps, and total power in watts through the room controller
- h. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings
- i. Activate a preset scene for the room
- j. Read/write daylight sensor fade time and day and night setpoints
- k. Read the current light level, in footcandles, from interior and exterior photosensors and photocells
- l. Set daylight sensor operating mode
- m. Read/write wall switch lock status
- n. Read watts per square foot for the entire controlled room
- o. Write maximum light level per load for demand response mode
- p. Read/write activation of demand response mode for the room
- q. Activate/restore demand response mode for the room

B. WattStopper product numbers: LMBC-300

2.14 Segment Manager:

- A. For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443).
- B. Each segment manager shall have integral support for at least three segment and format networks. Segment networks may alternately be connected to the segment manger via external routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the plans.
- C. Operational features of the Segment Manager shall include the following:
 - 1. Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.
 - 2. Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser. Shall not require installation of any lighting control software to an end-user PC.

3. Log in security capable of restricting some users to view-only or other limited operations.
 4. Automatic discovery of DLM devices and relay panels on the segment network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels.
 5. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.
 6. Ability to view and modify room device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.
 7. Ability to set up schedules for rooms and panels, view and override current status of panel channels and relays, and assign relays to groups. Schedules shall automatically set controlled zones or areas to either a normal hours or after hours mode of operation. Support for a minimum of 100 unique schedules, each with up to four time events per day. Support for annual schedules, holiday schedules and unique date-bound schedules.
 8. Ability to group rooms and loads for common control by schedules, switches or network commands.
 9. Ability to monitor connected load current and display power consumption for areas equipped with room controllers incorporating the integral current monitoring feature.
 10. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control.
 11. The Segment Manager shall allow access and control of the overall system database via Native Niagara AX FOX connectivity. Systems that must utilize a Tridium Niagara controller in addition to the programming, scheduling and configuration server are not acceptable.
- D. Segment Manager shall support multiple DLM rooms as follows:
1. Support up to 120 network bridges and 900 digital in-room devices (LMSM-3E).
 2. Support up to 300 network bridges and 2,200 digital in room devices, connected via network routers and switches (LMSM-6E).
- E. WattStopper Product Numbers: LMSM-3E, LMSM-6E, NB-ROUTER, NB-SWITCH, NB-SWITCH-8, NB-SWITCH-16.

2.15 Programming, Configuration and Documentation Software:

- A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.

1. Additional parameters exposed through this method include but are not limited to:
 - a. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
 - b. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
 - c. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
 - d. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
 - e. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
 - f. Load control polarity reversal so that on events turn loads off and vice versa.
 - g. Per-load DR (demand response) shed level in units of percent.
 - h. Load output pulse mode in increments of 1second.
 - i. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.
2. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
 - a. Device list report: All devices in a project listed by type.
 - b. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
 - c. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
 - d. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
 - e. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
 - f. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100%, 2 = all loads 75%, 3 = all loads 50%, 4 = all loads 25%, 5-16 = same as scene 1).
 - g. Occupancy sensor report: Basic settings including time delay and sensitivity(ies) for all occupancy sensors.
3. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:

- a. Set, copy/paste an entire project site of sensor time delays.
 - b. Set, copy/paste an entire project site of sensor sensitivity settings.
 - c. Search based on room name and text labels.
 - d. Filter by product type (i.e. LMRC-212) to allow parameter set by product.
 - e. Filter by parameter value to search for product with specific configurations.
4. Network-wide firmware upgrading remotely via the BACnet/IP network.
- a. Mass firmware update of entire rooms.
 - b. Mass firmware update of specifically selected rooms or areas.
 - c. Mass firmware upgrade of specific products.
- B. WattStopper Product Number: LMCS-100, LMCI-100

2.16 Emergency Lighting Control Devices:

- A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
 2. Push to test button
 3. Auxiliary contact for remote test or fire alarm system interface
- B. WattStopper Product Numbers: ELCU-100, ELCU-200.

PART 3 – EXECUTION

3.01 Pre-installation Meeting:

- A. A factory authorized manufacturer's representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:
1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.
 2. Review the specifications for low voltage control wiring and termination.
 3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
 4. Discuss requirements for integration with other trades.

3.02 Contractor Installation and Services:

- A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.

- B. Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufacturer with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.
- C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.
- D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
 - 1. Adjust time delay so that controlled area remains lighted while occupied.
- E. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
- F. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activity.

3.03 Factory Services:

- A. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system.
- B. The electrical contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date.
- C. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

3.04 Commissioning Support Services:

- A. On this project, a commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturer should include an extra day of technician's time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.

- B. The commissioning agent shall work with the electrical contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the contractor and manufacturer shall ensure that interfacing with the agent does not prevent them from completing the requirements outlined in the contract documents.

3.05 Acceptance Testing Support Services:

- A. On all California projects, a certified lighting controls acceptance test technician (CLCATT) must verify the installation of the lighting control system. Manufacturer should include an extra day of factory technician's time to assist the CLCATT review the functionality and settings of the lighting control hardware per the requirements in the California State forms. It will be the CLCATT's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the CLCATT with this task.

3.06 Lighting Control Installation Certificate Requirements:

- A. When certification is required by Title 24, Part 1, Section 10-103-A, the acceptance testing specified by Section 130.4 shall be performed by a Certified Lighting Controls Acceptance Test Technician (CLCATT) employed or hired by the electrical contractor. If the CLCATT is operating as an employee, the CLCATT shall be employed by a Certified Lighting Controls Acceptance Employer. The CLCATT shall disclose on the Certificate of Acceptance a valid CLCATT certification identification number issued by an approved Acceptance Test Technician Provider. The CLCATT shall complete all Certificate of Acceptance documentation in accordance with the applicable requirements in Section 10-103(a)4.
- B. Lighting Control Installation Certificate Requirements. To be recognized for compliance with Part 6 an Installation Certificate shall be submitted in accordance with Section 10-103(a) for any lighting control system, Energy Management Control System, track lighting integral current limiter, track lighting supplementary overcurrent protection panel, interlocked lighting system, lighting Power Adjustment Factor, or additional wattage available for videoconference studio, in accordance with the following requirements, as applicable:
 1. Certification that when a lighting control system is installed to comply with lighting control requirements in Part 6 it complies with the applicable requirements of Section 110.9; and complies with Reference Nonresidential Appendix NA7.7.1.
 2. Certification that when an Energy Management Control System is installed to function as a lighting control required by Part 6 it functionally meets all applicable requirements for each application for which it is installed, in accordance with Sections 110.9, 130.0 through 130.5, 140.6 through 150.0, and 150.2; and complies with Reference Nonresidential Appendix NA7.7.2.
 3. Certification that line-voltage track lighting current limiters comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.3.
 4. Certification that line-voltage track lighting supplemental overcurrent protection panels comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.4.
 5. Certification that interlocked lighting systems used to serve an approved area comply with Section 140.6(a)1; and comply with Reference Nonresidential Appendix NA7.7.5.

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6. Certification that lighting controls installed to earn a lighting Power Adjustment Factor (PAF) comply with Section 140.6(a)2; and comply with Reference Nonresidential Appendix NA7.7.6.
7. Certification that additional lighting wattage installed for a videoconference studio complies with Section 140.6(c)Gvii; and complies with Reference Nonresidential Appendix NA 7.7.7.

END OF SECTION

SECTION 260924

DIGITAL LIGHTING MANAGEMENT RELAY CONTROL PANEL

PART 1 - GENERAL

1.01 Introduction:

- A. The work covered in this section is subject to the requirements in the General Conditions of division 01 and all sections of division 26 of the Specifications. Contractor shall coordinate the work in this section with the trades covered in other sections of the specification to provide a complete and operable system.

1.02 System Description:

- A. Extent of lighting control system work is indicated by drawings and by the requirements of this section. It is the intent of this section to provide an integrated, energy saving lighting control system including Lighting Control Panels, Occupancy Sensors, and Daylighting Controls from a single supplier. Contractor is responsible for confirming that the panels and sensors interoperate as a single system. When centralized line-voltage mounting or management is required, relay panel platforms being considered must have sufficient configuration flexibility to implement room-level code compliant controls sequences including, but not limited, to those referenced in section **2.01** of this specification.

1.03 Submittals:

- A. Submit manufacturer's data on lighting control system and components including shop drawings, detailed wiring diagrams, and cut sheets as required under related specification sections.
- B. Shop Drawings:
 - 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
 - 2. Show exact location of all digital devices and part numbers, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans.)
 - 3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
 - 4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

1.04 Quality Assurance:

- A. Manufacturers: Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Comply with NEC, NEMA, and FCC requirements for Class A applications.

- C. UL Approvals: Relay panels and accessory devices are to be UL listed under UL 916 Energy Management Equipment. Emergency relay panels shall be co-listed under UL 924 Emergency Lighting Equipment.

1.05 Manufacturers:

- A. This specification is based on products from WattStopper, Santa Clara, CA. Complete information on any other system proposed as a substitute must be submitted in writing for approval after bid and assorted cost saving. Prior approval does not guarantee final approval by the electrical engineer. The contractor shall be completely responsible for providing a system meeting this specification in its entirety. All deviations from this specification must be listed and individually signed off by the consultant.

PART 2 – PRODUCTS

2.01 Lighting Control Panels:

- A. Provide lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:
1. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 – 8 relays, 1 – 24 relays and 6 four-pole contactors, or 1 – 48 relays and 12 four-pole contactors.
 2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
 3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:
 - a. Removable, plug-in terminal blocks with screwless connections for all low voltage terminations.
 - b. Individual terminal block, override pushbutton, and LED status light for each relay.
 - c. Direct wired switch inputs associated with each relay and group channel shall support two-wire, momentary or maintained contact switches.
 - d. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches, digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs, digital IO modules capable of receiving momentary or maintained contact closure inputs, digital photocell modules, and digital occupancy sensors.
 - e. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.
 - f. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.
 - g. Group, channel, and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any group of relays can be

associated with a channel for direct on/off control or pattern (scene) control via a simple programming sequence using the relay and channel override pushbuttons and LED displays for channels 1-9 or a handheld IR programmer for channels 1-99.

- h. Relay group status for each channel shall be provided through red LED indicators for groups 1-9 and via BACnet for groups 1-99. Solid red indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.
 - i. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:
 - (1) Electrical:
 - (a) 30 amp ballast at 277V
 - (b) 20 amp tungsten at 120V
 - (c) 1.5 HP motor at 120V
 - (d) Relays shall be specifically UL listed for control of plug loads
 - (2) Mechanical:
 - (a) Individually replaceable, ½" KO mounting with removable Class 2 wire harness.
 - (b) Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.
 - (c) Dual line and load terminals each support two #14 – #12 solid or stranded conductors.
 - (d) Tested to 300,000 mechanical on/off cycles.
 - (3) Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
4. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
5. Lighting control panels shall be WattStopper model LMCP8, LMCP24 or LMCP48 as shown on the plans.

2.02 BACnet® Based Digital Communications:

- A. The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 master/slave token passing-based using the BACnet® protocol.
 - 1. The panel shall have provision for an individual BACnet device ID. The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.
 - 2. The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.
 - 3. Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 64. The state of each relay shall be readable and writable by the BAS via the object present value property.

4. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 64.
5. The 99 channel groups associated with the panel shall be represented by binary value objects in the instance range of 201 – 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the after hours mode.
6. Setup and commissioning of the panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:
 - a. Binary output objects in the instance range of 1 – 64 (one per relay) for on/off control of relays.
 - b. Binary value objects in the instance range of 1 – 99 (one per channel) for normal hours/after hours schedule control.
 - c. Binary input objects in the instance range of 1 – 64 (one per relay) for reading true on/off state of the relays.
 - d. Analog value objects in the instance range of 1 – 64 (one per relay) shall assign relays to channel groups in the range of 1 – 99.
 - e. Analog value objects in the instance range of 101 – 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute gracetime period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.
 - f. Analog value objects in the instance range of 201 – 299 (one per channel) shall assign an after hours time delay value to the channel in the range of 1 – 240 minutes.
 - g. Multi-state value objects in the instance range of 1 – 99 (one per channel) shall provide the state of the relays assigned to the channel. Valid states shall be ALL ON, MIXED, BLINK, and ALL OFF.
7. The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel.
8. The BO and BV 1 – 99 objects shall support BACnet priority array with a relinquish default of off and after hours respectively. Prioritized writes to the channel BV objects shall propagate prioritized control to each member relay in a way analogous to the BACnet Channel object described in addendum aa. (<http://www.bacnet.org/Addenda/Add-135-2010aa.pdf>)
9. Panel-aggregate control of relay Force Off at priority 2 shall be available via a single BV5 object. Force On at priority 1 shall be available via a single BV4 object.
10. Lockout of all digital switch buttons connected to a given panel shall be command-able via a single BV2 object. The lock status of any connected switch station shall be represented as BV101-196.

11. Lighting control accessory devices connected to the panel shall be represented via BACnet objects including but not limited to the following:
 - a. Digital occupancy sensor detection states shall be readable as BI objects ranging from BI1-96.
 - b. Digital occupancy sensor configuration parameters shall each be accessible as BACnet objects when applicable to a given product.
 - (1) Occupancy sensor time delay in minutes shall be writeable via AV101-196.
 - (2) Occupancy sensor passive infrared (PIR) sensitivity percentage shall be writeable via AV201-296.
 - (3) Occupancy sensor ultrasonic (US) sensitivity percentage shall be writeable via AV301-396.
 - c. Digital switch buttons shall be readable and writeable as BI objects ranging from BI101 – 9608.
 - d. Digital daylight sensors foot-candle readings shall be readable as follows:
 - (1) Analog 0-5V/0-10V sensors connected to a digital input module shall be represented as AI1-96.
 - (2) Digital closed loop sensors shall be represented as AI4001-4096.
 - (3) Digital open loop sensors shall be represented as AI5001-5096.
 - (4) Digital dual loop sensors shall be represented as follows:
 - (a) The upward facing open loop sensor shall be represented as AI6001-6096.
 - (b) The downward facing closed loop sensor shall be represented as AI6101-6196.
 - e. Digital daylight sensor configuration shall be exposed as BACnet objects as follows:
 - (1) Digital closed loop sensors shall be represented as follows:
 - (a) Daylight Sensor Day Setpoint (ftcd) AV4201-4296.
 - (b) Daylight Sensor Night Setpoint (ftcd) AV4301-4396.
 - (c) Daylight Sensor Off Setpoint Delay (minutes) AV4401-4496.
 - (d) Daylight Sensor On Setpoint (ftcd) AV4501-4596.
 - (e) Daylight Sensor Off Setpoint (ftcd) AV4601-4696.

2.03 User Interface:

- A. Each lighting control panel system shall be supplied with at least (1) handheld IR remote programming interface consisting of a keypad and associated OLED display screen. The user interface shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following functions as a minimum:
 1. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.

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2. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.
3. Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.
4. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.
5. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
6. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.
7. An additional handheld IR remote may optionally be specified to be permanently mounted to the panel interior via a retractable anti-theft lanyard to allow for convenient programming of the panel while assuring that the handheld programmer is always present at that panel. An unlimited number of handheld IR remotes may also be purchased for facilities staff as seen fit by the end user's representative.

2.04 Digital Network Switches:

- A. Provide digital wall switches with 1, 2, 3, 4, or 8 buttons, in the colors indicated on the plans. Switches shall connect to the panel via standard Cat 5e cable with RJ-45 terminations. Digital wall switches shall have the following features:
 1. Available colors: white, ivory, light almond, grey or black.
 2. Single gang device shall fit standard decorator opening and use standard wall plates.
 3. LED indicator on each button for status and locator function.
 4. Concealed configuration button with LED indicator for binding buttons to relays, no software or computer shall be required.
 5. Infrared window for use with handheld two-way wireless configuration tool,
 6. Selectable function mode per button shall be momentary toggle (on/off), on only, or off only.
 7. Removable button assembly for field color change or substitution of engraved buttons.
 8. Two RJ-45 ports for connection to panel or other switches and/or occupancy sensors.
 9. Open topology digital network via Cat 5e wire.
 10. Digital switches shall be WattStopper LMSW series as indicated on the plans.

11. Digital switch buttons shall be able to control groups and group actions shall be system global such that any digital switch station can affect the state of relays present in up to (12) twelve panels networked together via BACnet.

2.05 Digital Occupancy Sensors:

- A. Provide digital occupancy sensors to control relays in locations as shown on the plans. Sensors shall be either passive infrared, ultrasonic, or dual technology as indicated. Sensors shall be either ceiling or wall mounded and connect to the panel using Cat 5e cable with RJ-45 terminations. Digital occupancy sensors shall have the following features:
 1. Setup and calibration shall be digital and precisely repeatable from sensor to sensor.
 2. User interface with pushbuttons and illuminated LCD screen for setup and calibration.
 3. Ladder-free setup and calibration with optional handheld two-way infrared commissioning tool.
 4. Sensitivity, 0 – 100% in 10% increments.
 5. Time delay, 1 – 30 minutes in 1 minute increments.
 6. Test mode with five-second time delay for simplified walk testing.
 7. Digital occupancy sensors shall be WattStopper LM series as indicated on the plans.
 8. Digital occupancy sensors shall be able to control groups and group actions shall be system global such that any digital occupancy sensor can affect the state of relays present in up to (12) twelve panels networked together via BACnet.

2.06 Digital Network Clock:

- A. Each panel shall include a digital clock capability able to issue system wide automation commands to up to (11) eleven other panels for a total of (12) twelve networked lighting control panels. The clock shall provide capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups.
 1. The clock capability of each panel shall support all of the energy saving features required of ASHRAE 90.1 - 2001, IECC 2003, as well as all state and local energy codes.
 2. The clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back up for the clock function and EEPROM for program retention. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.
 3. The clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:
 - a. Scheduled ON / OFF
 - b. Manual ON / Scheduled OFF
 - c. Astro ON / OFF (or Photo ON / OFF)
 - d. Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)

4. The user interface shall be a portable IR handheld remote control capable of programming any panel in the system.
5. The clock capability of each panel shall employ non volatile memory and shall retains user programming and time for a minimum of 10 years.
6. Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.

2.07 Application Sequence of Operations Support:

- A. The lighting control panel shall support relay behavior parameter configuration of such an extent as to allow digital switch, digital occupancy sensor, digital automatic photocells, and scheduled events to seamlessly implement, at a minimum, the following operational sequences:
 1. Title 24 operation requiring Manual On 50%, Automatic on 100%, automatic shut-off on vacancy shall be able to be implemented by using any two relays in a given panel. The sensor(s) for that space will be bound to both relays, each of which shall be given an independent operation mode of Auto On and Manual On respectively, such that on occupancy only 50% of the lighting activates. The digital switch stations for the space, having at minimum two buttons, shall be bound to both relays such that at least one button controls only 50% of the lights and at least one separate button controls only the remaining 50% of the lights allowing for independent zone control. The occupancy sensor(s) action on vacancy shall be to turn off both relays. Configuration of this operational sequence shall not require special software or tools and shall be accomplished using only the handheld IR remote control.
 2. Open office spaces that must turn on automatically by sensor during the Normal Hours operating period and stay on until a scheduled sweep of the space on transition to the After Hours operating shall use the handheld IR remote control to create a group of the relays for that space with a group parameter type that automatically adjust the Normal Hours and After Hours run-time parameters to the required values. Relay operation during Normal Hours shall therefore be for a relay to turn on when its respective occupancy sensor(s) detect motion and to stay on until the After Hours sweep time. Once the After Hours sweep occurs, all relays shall operate as automatic ON/OFF in response to their respective sensors. Systems that require individual relay parameters to be adjusted on a per relay basis are not acceptable.
 3. Private office spaces that must operate as manual on/manual off during Normal Hours and automatic on/automatic off during After Hours with no sweep off on transition to After Hours operation shall use the handheld IR remote control to create a group of the relays that must follow that operational sequence using a group parameter type that automatically adjusts the Normal Hours and After Hours run-time parameters to the required values. Relay operation during Normal Hours shall therefore be for a relay to turn on only when a digital switch station button bound to it is activated and to turn off automatically in response to the vacancy signal of all occupancy sensors bound to it. Systems that require individual relay parameters to be adjusted on a per relay basis are not acceptable.

2.08 Schedule, Group, and Photocell Control of Relays:

- A. The lighting control panel shall support schedule, group, and photocell control functions via the network as configured in the optional Segment Manager controller or building automation system. The lighting control panel shall be fully compatible with building automation systems

that are BACnet compliant. See related specification sections for additional information on interfacing the lighting control panel(s) to the building automation system.

2.09 Browser-based Programming and Control:

- A. The relay panel system shall be capable of use in conjunction with an optional digital web-based appliance such as the WattStopper Segment Manager. Such a controller shall be a compact controller capable of hosting the schedule, photocell, and group relay control functions for a network of LMCP series lighting control panels. The segment manager shall provide the following features:
1. Provision for 1 to 3 separate network segments to facilitate efficient network wire routing.
 2. Compact housing with screw tab mounts for surface installation and integral DIN rail mounting slot for NEMA 1 installation in the LMSM-ENC1 enclosure.
 3. Web browser-based user interface; shall not require the installation of any lighting control software.
 4. User interface accessible from most smart phone browsers when Internet connected.
 5. Login security access control restricting some users to view-only or other limited operations.
 6. Automatic discovery of the lighting control panels.
 7. Familiar navigation-tree-based browsing to individual lighting control panels.
 8. View/override current status of channels and relays.
 9. Assign relays to groups.
 10. Create and run schedules:
 - a. Normal hours/after hours schedules for channels.
 - b. On/off schedules for relays.
 - c. Support for a minimum of 100 unique schedules, each with up to four time events per day.
 - d. Support annual schedules, holiday schedules and unique date-bound schedules.
 11. Ethernet connectivity for user access via direct-wired connection, LAN/WAN, or Internet connection.
 12. BACnet IP connectivity for connection to building automation systems.
 13. Segment manager shall be WattStopper LMSM-201 with one network segment or LMSM-603 with support for three network segments.
 14. Support for additional segments beyond 3 must be possible via the addition of standard BACnet MS/TP routers. The use of gateway devices or other proprietary protocols for system expansion is not acceptable.

PART 3 – EXECUTION

3.01 Support Services:

A. System Start Up and Commissioning

1. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of the lighting control panels, switches, and occupancy sensors.
2. The technician shall provide training on the lighting control features of the system and shall verify that the panel(s) is communicating with the building automation system.
3. The technician shall provide 1 – day of additional training and configuration of operation 60 days after final acceptance of project by owner.
4. The system integrator or BAS vendor shall be responsible for all integration including the mapping of BACnet objects into the BAS logic, schedules and graphics.

3.02 Acceptance Testing Support Services:

- A. On all California projects, a certified lighting controls acceptance test technician (CLCATT) must verify the installation of the lighting control system. Manufacturer should include an extra day of factory technician's time to assist the CLCATT review the functionality and settings of the lighting control hardware per the requirements in the California State forms. It will be the CLCATT's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the CLCATT with this task.

3.03 Lighting Control Installation Certificate Requirements:

- A. When certification is required by Title 24, Part 1, Section 10-103-A, the acceptance testing specified by Section 130.4 shall be performed by a Certified Lighting Controls Acceptance Test Technician (CLCATT) employed or hired by the electrical contractor. If the CLCATT is operating as an employee, the CLCATT shall be employed by a Certified Lighting Controls Acceptance Employer. The CLCATT shall disclose on the Certificate of Acceptance a valid CLCATT certification identification number issued by an approved Acceptance Test Technician Provider. The CLCATT shall complete all Certificate of Acceptance documentation in accordance with the applicable requirements in Section 10-103(a)4.
- B. Lighting Control Installation Certificate Requirements. To be recognized for compliance with Part 6 an Installation Certificate shall be submitted in accordance with Section 10-103(a) for any lighting control system, Energy Management Control System, track lighting integral current limiter, track lighting supplementary overcurrent protection panel, interlocked lighting system, lighting Power Adjustment Factor, or additional wattage available for videoconference studio, in accordance with the following requirements, as applicable:
 1. Certification that when a lighting control system is installed to comply with lighting control requirements in Part 6 it complies with the applicable requirements of Section 110.9; and complies with Reference Nonresidential Appendix NA7.7.1.
 2. Certification that when an Energy Management Control System is installed to function as a lighting control required by Part 6 it functionally meets all applicable requirements for each application for which it is installed, in accordance with Sections 110.9, 130.0 through 130.5,

140.6 through 150.0, and 150.2; and complies with Reference Nonresidential Appendix NA7.7.2.

3. Certification that line-voltage track lighting current limiters comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0©; and comply with Reference Nonresidential Appendix NA7.7.3.
4. Certification that line-voltage track lighting supplemental overcurrent protection panels comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.(c); and comply with Reference Nonresidential Appendix NA7.7.4.
5. Certification that interlocked lighting systems used to serve an approved area comply with Section 140.6(a)1; and comply with Reference Nonresidential Appendix NA7.7.5.
6. Certification that lighting controls installed to earn a lighting Power Adjustment Factor (PAF) comply with Section 140.6(a)2; and comply with Reference Nonresidential Appendix NA7.7.6.
7. Certification that additional lighting wattage installed for a videoconference studio complies with Section 140.6(c)Gvii; and complies with Reference Nonresidential Appendix NA 7.7.7.

END OF SECTION

SECTION 262200

TRANSFORMERS

PART 1 - GENERAL

1.01 Description of Work:

- A. The work of this section consists of providing dry type transformers as shown on Drawings and as described in this section.

1.02 Related Work:

- A. See the following specification sections for work related to the work in this section.
 - 1. 260519 Line Voltage Wire and Cable.
 - 2. 260526 Grounding.

1.03 Submittals: In accordance with Division 01.

- A. Shop Drawings: Submit manufacturer's name and nameplate data as follows:
 - 1. KVA rating.
 - 2. Nominal primary voltage.
 - 3. Tap voltages.
 - 4. Nominal secondary voltage.
 - 5. Percent impedance.
 - 6. Weight.
 - 7. Physical dimensions and mounting requirements.
- B. Submit manufacturer's no-load loss value for transformer.
- C. Operation and Maintenance Data: Submit the manufacturer's operation and maintenance data in accordance with Division 01. Copies of the factory and field test reports shall be included in this submittal.

1.04 Factory Testing:

- A. Tests on transformers shall include the manufacturer's standard tests, including winding resistance, ratio, polarity, phase relation, no-load loss, impedance, full load losses, and dielectric tests. Certified copies shall show compliance with all referenced standards.

PART 2 - PRODUCTS:

2.01 Dry Type Transformer:

- A. Unless otherwise noted on the Drawings, general purpose transformers for supplying lighting and small power loads shall be dry type, two winding, 60 Hertz, aluminum windings, temperature rise not exceeding 150 C under full load in an ambient of 40 C, with Class H 220 C insulation. Capacity rating, number of phases and voltages shall be as shown on the

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Drawings. Transformer shall comply with all applicable provisions of NEMA Standard ST20 and shall have NEMA Standard taps. Transformers rated below 15 KVA shall have two (2) 5% full capacity taps below rated primary volts and transformers rated 15 KVA and above shall have six (6) 2-1/2% full capacity taps, two above the four below nominal voltage Terminal compartment shall have a temperature rise not to exceed 35 C. Provide unit UL listed for indoor/outdoor mounting. Provide dry-type transformer as manufactured by Square D, Siemens, General Electric Company or approved equal.

- B. Transformers shall be low loss type with minimum efficiencies per NEMA TP-1 when operated at 35% of full load capacity. Efficiency shall be tested in accordance with NEMA TP-2.
- C. Transformers installed outdoors shall be NEMA 3R, Unless otherwise noted on the Drawings.
- D. Transformer sound levels shall not exceed the following values;
 - 1. 0-9 KVA 40 decibels
 - 2. 10-50 KVA 45 decibels
 - 3. 51-150KVA 50 decibels
 - 4. 151-300KVA 55 decibels
 - 5. 301-500KVA 60 decibels

PART 3 - EXECUTION

3.01 Transformer Installation:

- A. Transformer shall be where indicated on the Drawings. Indoor transformers shall have code and manufacturers recommended clearances from adjacent walls. In no case should this clearance be less than six inches.
- B. Transformer shall be connected with flexible liquid tight metallic conduit to prevent the transmission of sound through the conduit system. All transformers shall be installed on resilient vibration-isolating mounting pads.
- C. Transformer neutral grounding shall be sized in accordance with requirements for separately derived systems and shall be connected to the nearest cold water pipe with supplementary driven ground. Ground rod and connections shall be as detailed in Section 16060 [26 05 26].

3.02 Field Tests:

- A. Insulation-Resistance Tests: 480 volt windings shall be tested with a 1000 volt megohm meter; 208 or 240 shall be tested with a 500 volt megohm meter. All tests shall be applied for not less than 5 minutes and until three consecutive readings, one minute part, are obtain. Readings shall be recorded every 30 seconds for the first two minutes and every minute thereafter.
- B. Acceptance: Acceptance with be based on satisfactory completion of the insulation resistance tests.

END OF SECTION

SECTION 262416

PANELBOARDS AND DISTRIBUTION PANELS

PART 1 – GENERAL

1.01 Description of Work:

- A. The work of this Section consists of providing panelboards and circuit breakers as shown on the Drawings and as described herein.

1.02 Related Work:

- A. See the following specification sections for work related to the work in this Section.
 - 1. 260519 Line Voltage Wire and Cable
 - 2. 260526 Grounding
 - 3. 262816 Circuit Breakers

1.03 Submittals:

- A. Shop Drawings - As specified in Division 01 and Section 260500. For each panelboard and distribution panel furnished under this Contract, submit manufacturer's name, catalog data, and the following information:
 - 1. Panelboard / distribution panel type.
 - 2. Main bus and terminal connection sizes.
 - 3. Location of line connections.
 - 4. Cabinet dimension.
 - 5. Gutter space.
 - 6. Gauge of boxes and fronts.
 - 7. Finish data.
 - 8. Voltage rating.
 - 9. Breaker manufacturer, types, trip rating, and interrupting ratings.
 - 10. When information is available on the Drawings, show breaker circuit numbers and locations along with trip ratings on a panelboard layout.
- B. Single Submittal - A single complete submittal is required for all products covered by this Section.
- C. Closeout Submittals: Submit operation and maintenance data for panelboards and circuit breakers including nameplate data, parts lists, factory and field test reports, recommended maintenance procedures and typewritten as-built panel schedules. Submit in accordance with Division 01.

PART 2 – PRODUCTS

2.01 Panelboards:

- A. General: Lighting and Receptacle Panelboards shall be the automatic circuit breaker type. The number and arrangement of circuits, trip ratings, spares and blank spaces for future circuit breakers shall be as shown on the Drawings or, if not shown, 42 circuits. All circuit breakers shall be quick-make, quick-break, thermal-magnetic, bolt-on type (unless otherwise noted on drawings), with 1, 2 or 3 poles as shown, each with a single operating handle. Tandem or piggy-back breakers shall not be used.
- B. Nameplates:
 - 1. Each panelboard shall have a field mounted identifying, rigid, plastic nameplate giving the panel identification as shown on the Drawings.
 - 2. Each panelboard shall have a manufacturer's nameplate showing the voltage, bus rating, number of phases, frequency and number of wires.
- C. Construction:
 - 1. Door and trim shall be finished to match finish type and color of surrounding wall. Box shall be hot-dip galvanized, field finished to match the front.
 - 2. Panelboards and enclosures shall conform to requirements of all relevant codes. Panelboards shall be suitable for use as service equipment.
 - 3. Panelboards shall be furnished with hinged trim fronts with key latch and a typed directory card and holder. Panelboard circuits shall be arranged with odd numbers on the left and even numbers on the right. Provide weatherproof, NEMA type 3R enclosures for outdoor installation.
- D. Busbars: Panelboard busbars shall be phase sequence type suitable for bolt-on circuit breakers. All busbars shall be copper.
- E. Circuit Breakers: Circuit breakers shall be the molded case type with trip and interrupting ratings as shown on the Drawings.
- F. Manufacturer:
 - 1. Panelboard manufacturer shall be Square D, or Siemens, or I.E.M , or General Electric, or Eaton Cutler Hammer. Panelboards shall be of the same manufacturer as the switchboard.

2.02 Distribution Panels:

- A. General: Distribution panels shall be the automatic circuit breaker type. The number and arrangement of circuits, trip ratings, spares and blank spaces for future circuit breakers shall be as shown on the Drawings. All circuit breakers shall be quick-make, quick-break, thermal-magnetic bolt-on type, with 1, 2 or 3 poles as shown, each with a single operating handle. Tandem or piggy-back breakers shall not be used.
- B. Nameplates:
 - 1. Each distribution panel shall have a field mounted, identifying, rigid, plastic nameplate giving the panel identification as shown on the Drawings.

2. Each distribution panel shall have a manufacturer's nameplate showing the voltage, bus rating, number of phases, frequency and number of wires.

C. Construction:

1. Door and trim shall be finished to match color of surrounding wall. Box shall be hot-dip galvanized, field finished to match the front.
2. Distribution panels and enclosures shall conform to requirements of all relevant codes. Distribution panels shall be suitable for use as service.
3. Distribution panels shall have a front door with key latch and a typed directory card and permanently attached holder. Adhesive backed holders are not acceptable. Distribution panels circuits shall be arranged with odd numbers on the left and even numbers on the right. Provide weatherproof, NEMA type 3R enclosures for outdoor installation.

D. Busbars: Distribution panels busbars shall be phase sequence type suitable for bolt-on circuit breakers. All busbars shall be copper, sized for a maximum current density of 1000A psi.

E. Circuit Breakers: Circuit breakers shall be the molded case type with trip and interrupting ratings as shown on the Drawings.

F. Manufacturer:

1. Distribution panel manufacturer shall be Square D, or Siemens, or I.E.M., or General Electric, or Eaton Cutler Hammer. Distribution panels shall be of the same manufacturer as the switchboard.

PART 3 – EXECUTION

3.01 Installation: Panelboards and Distribution Panels shall be installed where indicated on the Drawings, and in accordance with the manufacturer's instructions.

3.02 Mounting:

- A. Panelboards and Distribution Panels shall be mounted with the top of the box 6'-6" above the floor. Panelboards and Distribution Panels shall be plumb within 1/8-inch. The highest breaker operating handle shall not be higher than 72 inches above the floor.

3.03 Field Tests:

- A. Insulation Resistance Tests: Perform insulation resistance tests on circuits with #2 AWG and larger conductors to be energized with a line-to-neutral voltage of 120 volts or more. Make these tests after all equipment has been connected, except that equipment which may be damaged by the test voltage shall not be connected. Test the insulation with a 500Vdc insulation resistance tester with a scale reading 100 megohms. The insulation resistance shall be 2 megohms or more. Submit results for review.
- B. Grounding: Grounding shall conform to Section 260526.
- C. Continuity: Panelboard and Distribution Panel circuits shall be tested for continuity prior to energizing. Continuity tests shall be conducted using a dc device with a bell or buzzer.

END OF SECTION

SECTION 262726

DEVICES WIRING

PART 1 – GENERAL

1.01 Description of Work

A. The work of this section consists of:

1. Furnishing, installing, and connecting all duplex receptacles complete with wall plates and/or covers, as shown on the Drawings.
2. Furnishing, installing and connecting all light switches complete with wall plates and or handle operators, as shown on the Drawings.

1.02 Related Work:

A. See the following specification sections for work related to the work of this section:

1. 260542 Conduits, Raceways and Fittings.
2. 260519 Line Voltage Wire and Cable.
3. 260533 Junction and Pull Boxes.

1.03 Submittals: As specified in Section 260500 and Division 01.

- A. Submit manufacturers published descriptive literature properly marked to identify the items to be supplied.
- B. A single complete submittal is required for all products covered by this Section.

PART 2 – PRODUCTS

2.01 Receptacles:

A. General - Receptacles shall be heavy duty, high abuse, grounding type.

B. Duplex Receptacles:

1. Receptacles shall be specification grade, rated 20 ampere, two-pole, 3-wire, 125 volt, NEMA 5-20 configuration, self-grounding with screw terminals. Color shall be as selected by the Architect.
2. Devices shall have a nylon face, back and side wired.
3. Manufacturer: Hubbell #DR20 Series, Leviton #16352 Series.

C. GFCI Receptacles:

1. Device shall be rated 20 ampere, 2-pole, 3-wire, 120 volt, conforming to NEMA 5-20 configuration. Face shall be nylon composition. Unit shall have an LED type red indicator light, test and reset push buttons. Color shall be as selected by the Architect.
2. GFCI component shall meet UL 943 Class A standards with a tripping time of 1/40 second at 5 milliamperes current unbalance. Operating range shall extend from -31 F to 158 F.

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Unit shall have transient voltage protection and shall be ceramic encapsulated for protection against moisture.

3. Manufacturer: Hubbell #GF20__LA Series, Leviton #7899 Series.

2.02 Switches:

- A. Switches shall be rated 20 amperes to 120/277 volts ac. Units shall be flush mounted, self-grounding, quiet operating rocker devices. Rocker color shall be as selected by the Architect.
 1. Manufacturer: Hubbell #DS_20__ Series, Leviton #5621 Series. See plans for single pole, three way and four way requirements.
- B. Timed switches: Shall be as designed by Paragon Electric Company # ET2000f or Watt Stopper TS-200 rated for the voltage specified on drawings. Time-out shall be adjustable from 5 minutes up to 12 hours. Unit shall be provided with warning alarm.
- C. Dimmer switches: Switch shall be as specified on drawings, color per architect. Heat fins shall not be removed, where dimmer switches are ganged together, care shall be taken to install correct size backbox to accommodate switches without removing fins.

2.03 Plates:

- A. General - Plates shall be of the style and color to match the wiring devices, and of the required number of gangs. Plates shall conform with NEMA WD 1, UL 514 and FS W-P-455A. Plates on finished walls shall be non-metallic or stainless steel. Plates on unfinished walls and on fittings shall be of zinc plated steel or case metal and shall have rounded corners and beveled edges.
- B. Non-Metallic: Plates shall be plain with beveled edges and shall be nylon or reinforced fiberglass.
- C. Stainless Steel: Plates shall be .040 inches thick with beveled edges and shall be manufactured from No. 430 alloy having a brushed or satin finish.
- D. Cast Metal: Plates shall be cast or malleable iron covers with gaskets so as to be moisture resistant or weatherproof.
- E. Blank Plates: Cover plates for future telephone outlets shall match adjacent device wall plates in appearance and construction.
- F. Weatherproof Plate: Cover plates in wet and damp locations shall have recessed in-use covers, Taymac or equal. Back box shall be suitable for the wall material where it is installed.
- G. Labeling: All switch and receptacle plates shall be labeled on the top portion of the plate with the panelboard and circuit number serving that device. Lettering shall be 3/16" minimum high, black color, on clear Mylar 3/8" tape. Manufactured by P-touch or equal.

PART 3 – EXECUTION

3.01 Installation of Wiring Devices:

- A. Interior Locations: In finished walls, install each device in a flush mounted box with washers as required to bring the device mounting strap level with the surface of the finished wall. On unfinished walls, surface mount boxes level and plumb.

B. Mounting Heights: Adjust boxes so that the front edge of the box shall not be farther back from the finished wall plane than 1/4-inch. Adjust boxes so that they do not project beyond the finished wall. Height of device shall be as follows unless otherwise noted on the drawings:

1. Receptacles 15 Inches from finished floor to bottom of box.
2. Toggle Switches 48 Inches from finished floor to top of box.

C. Receptacles:

1. Ground each receptacle using a grounding conductor, not a yoke or screw contact.
2. Install receptacles with connections spliced to the branch circuit wiring in such a way that removal of the receptacle will not disrupt neutral continuity and branch circuit power will not be lost to other receptacles in the same circuit.

3.02 Installation of Wall Plates:

- A. General - Plates shall match the style of the device and shall be plumb within 1/16-inch of the vertical or horizontal.
- B. Interior Locations, Finished Walls: Install non-metallic plates so that all four edges are in continuous contact with the finished wall surfaces. Plaster filling will not be permitted. Do not use oversized plates or sectional plates.
- C. Interior (not wet) Locations, Unfinished Walls: Install stainless steel or cast metal cover plates.
- D. Wet Locations: Install cast metal plates with gaskets on wiring devices in such a manner as to provide a rain tight weatherproof installation. Cover shall be [lockable] outdoor "in use" type.
- E. Future Locations: Install blanking cover plates on all unused outlets.

3.03 Tests:

A. Receptacles:

1. After installation of receptacles, energize circuits and test each receptacle to detect lack of ground continuity, reversed polarity, and open neutral condition.

END OF SECTION

SECTION 262816

CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 Description of Work:

- A. The work of this Section consists of providing circuit breakers as shown on the Drawings and as described herein.

1.02 Related Work: See the following Specification Sections for work related to the work in this Section.

- A. 260500 General Electrical Requirements
- B. 262413 Switchboards
- C. 262416 Panelboards and Distribution Panels

1.03 Submittals:

- A. Shop Drawings - Submittals shall be in accordance with Section 260500 and Division 01. For each circuit breaker furnished under this Contract, submit manufacturer's name, catalog data, and the following information:
 - 1. Terminal connection sizes.
 - 2. Voltage rating.
 - 3. Breaker manufacturer, types, trip ratings and interrupting ratings.
- B. Single Submittal - A single complete submittal is required for all products covered by this Section.
- C. Closeout Submittals: Submit in accordance with and Section 260500, operation and maintenance data for circuit breakers including nameplate data, parts lists, manufacturer's circuit breaker timer, current, coordination curves, factory and field test reports and recommended maintenance procedures.

PART 2 - PRODUCTS

2.01 Circuit Breaker: Each circuit breaker shall consist of the following:

- A. A molded case breaker with an over center toggle-type mechanism, providing quick-make, quick-break action. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. Multipole circuit breakers shall have variable magnetic trip elements which are set by a single adjustment to assure uniform tripping characteristics in each pole. Circuit breakers shall be of the bolt-on type unless otherwise noted.
- B. Breaker shall be calibrated for operation in an ambient temperature of 40 C.
- C. Each circuit breaker shall have trip indication by handle position and shall be trip-free.
- D. Three pole breakers shall be common trip.

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- E. The circuit breakers shall be constructed to accommodate the supply connection at either end of the circuit breaker. Circuit breaker shall be suitable for mounting and operation in any position.
- F. Breakers shall be rated as shown on Drawings.
- G. Circuit breaker and/or Fuse/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations for use in the end use equipment in which it is installed. Any series rated combination used shall be marked on the end use equipment per CEC section 110-22.
- H. Breakers shall be UL listed. Circuit breakers shall have removable lugs.
- I. Lugs shall be UL listed for copper and aluminum conductors.
- J. Breakers shall be UL listed for installation of mechanical screw type lugs.
- K. Circuit breakers serving HACR rated loads shall be HACR type. Circuit breakers serving other motor loads shall be motor rated.

PART 3 - EXECUTION

3.01 Mounting:

- A. The highest breaker operating handle shall not be higher than 72 inches above the floor.

END OF SECTION

SECTION 265100

LIGHTING

PART 1 – GENERAL

1.01 Description of Work:

- A. The work of this section consists of providing a lighting system complete, including fixtures, lamps, hangers, reflectors, glassware, lenses, auxiliary equipment, ballasts and sockets.

1.02 Related Work:

- A. See the following specification sections for work related to the work of this section:
 - 1. 260500 General Electrical Requirements.
 - 2. 260542 Conduit, Raceway and Fittings.
 - 3. 260519 Line Voltage Wire and Cable.
 - 4. 260533 Junction and Pull Boxes.

1.03 Submittals: In accordance with Division 01.

- A. Submit descriptive data, photometric curves for each fixture configuration proposed.
- B. Submit shop drawings showing proposed methods for mounting lighting fixtures.
- C. Seismic Requirements: Submit:
 - 1. Sketch or description of the anchorage system.
- D. Submit Operation and Maintenance Data per Division 01.

1.04 Warranty: High Intensity Discharge lamps which fail within the first year after final acceptance shall be replaced by the Contractor with the warranty clause of the General Provisions.

PART 2 – PRODUCTS

2.01 Fixtures

- A. Fixtures shall be of the types, wattage's and voltages shown on the Drawings and be UL classified and labeled for the intended use.
- B. Substitutions will not be considered unless the photometric distribution curve indicates the proposed fixture is equal to or exceeds the specified luminaire.
- C. Luminaire wire, and the current carrying capacity thereof shall be in accordance with the CEC.
- D. Luminaires and lighting equipment shall be delivered to the project site complete, with suspension accessories, aircraft cable, stems, canopies, hickey's, castings, sockets, holders, ballasts, diffusers, frames, and related items, including support and braces.

2.02 Ballasts:

- A. Ballasts shall be of the types shown on the drawings. Ballasts shall be CBM certified and bear the UL label. Magnetic ballasts shall be the high power factor type. Electronic ballasts shall be

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suitable for lamps specified by Advance, Magnetek/Universal, Motorola or approved equal. Electronic ballast shall be CBM certified and have a 10% maximum total harmonic distortion.

- B. All ballasts for fixtures installed outdoors shall provide reliable starting of lamps at 0 F at 90% of the nominal line voltage.
- C. Ballasts producing excessive noise (above 36 dB) or vibration will be rejected and shall be replaced at no expense to the Owner.

2.03 Lamps:

- A. Lamps shall be new at the time of acceptance and shall be General Electric, Osram /Sylvania, Phillips, or approved equal.
- B. Unless otherwise noted on the drawings, lamps shall be third generation T8, 3500 K, and 85 CRI minimum.
 - 1. Third Generation: Also known as High-Performance, Higher Lumen, or Super, the third generation of 32 Watt T8 lamps offers 3,100 lumens and a long-life rating of 24,000 hours. Efficacy is high, with lumens per watt in the range of 94 to 100. CRI is 82 to 86.

PART 3 – EXECUTION

3.01 Installation:

A. General:

- 1. All fixtures and luminaires shall be clean and lamps shall be operable at the time of acceptance.
- 2. Install luminaires in accordance with manufacturer's instructions, complete with lamps, ready for operation as indicated.
- 3. Align, mount, and level the luminaires uniformly.
- 4. Avoid interference with and provide clearance for equipment. Where an indicated position conflicts with equipment locations, change the location of the luminaire by the minimum distance necessary.

B. Mounting and Supports:

- 1. Mounting heights shall be as shown on the Drawings. Unless otherwise shown, mounting height shall be measured to the centerline of the outlet box for wall mounted fixtures and to the bottom of the fixture for suspended fixtures and to the bottom of the fixture for all other types.
- 2. Luminaire supports shall be anchored to structural members.
- 3. Pendant stem mounted luminaires shall be provided with ball aligners to assure a plumb installation and shall have a minimum 45 degree clean swing from horizontal in all directions. Sway bracing shall be installed as required to limit the movement of the fixture. Fixtures shall be allowed to sway a maximum of 45° without striking any object.
- 4. Fixture supports shall be designed to resist earthquake forces of seismic zone 4.
- 5. Refer to fixture mounting details on drawings for installation requirements.

6. Pendant cable mounted luminaries shall be provided with fully adjustable stainless steel aircraft cable hangers unless otherwise noted on the Drawings.

END OF SECTION

SECTION 271000

STRUCTURED CABLING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
- B. Division 26, Basic Materials and Methods sections apply to work specified in this section.

1.02 REFERENCE STANDARDS:

- A. ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-index Multimode Optical Fibers (OM3/OM4). Current Edition
- B. ANSI TIA-492.CAAB – Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak. Current Edition
- C. ANSI/TIA-568-C.0 – Generic Communications Cabling for Customer Premises.
- D. ANSI/TIA-568-C.1 – Commercial Building Communications Cabling Standard Part 1: General Requirements.
- E. ANSI/TIA-568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- F. ANSI/TIA-568-C.3 – Optical Fiber Cabling Components Standard
- G. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces.
- H. ANSI/TIA-606-B – Administration Standard for the Commercial Telecommunications Infrastructure.
- I. ANSI/JSTD-607-B – Commercial Building Bonding and Grounding (Earthing) Requirements for Telecommunications.
- J. NFPA 70 – National Electrical Code (NEC).
- K. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

1.03 DESCRIPTION OF WORK:

- A. The extent of telephone/data system work is indicated and is hereby defined to include, but not be limited to cable, raceway, outlet boxes, device plates, backboard, cabinets, grounding and miscellaneous items required for complete system.
- B. Provide complete cable and outlet system as indicated and described herein. Work includes cable, jacks, terminal blocks, wire management, labeling, transient voltage surge suppression,

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patch cords, and all terminations. Every cable, conductor and fiber strand installed under this Project shall be properly terminated at both ends and tested.

- C. Refer to other Division sections for requirements for raceways, boxes and fittings, wiring devices, and supporting devices, and other sections, as applicable.
- D. Provide system testing as described herein.

1.04 QUALITY ASSURANCE:

- A. Comply with applicable portions of NEC as to type products used and installation of components. Provide products and materials, which have been UL-listed and labeled. Comply with NEMA standards for low loss extended frequency cable and EIA/TIA TSB-36. Comply with EIA/TIA 568-A, EIA/TIA 569 and manufacturer's recommendations. Comply with EIA/TIA testing standards for horizontal cabling.

1.05 SUBMITTALS AND SUBSTITUTIONS:

- A. Submit manufacturer's data and installation details for all devices, plates, cable, terminal blocks, patch cords, TVSS, wire management, labels and similar equipment.
- B. Submit a copy of certification documents.
- C. Any substitution requests must be submitted in writing, and approved by Owner or Owner's Representative in writing prior to acceptance of bid.
- D. Substitution requests may only be made for products equal to or better than as specified in this document. Proof of "equal or better" status is imposed on the contractor, not the Owner.
- E. Where a specific manufacturer is called out by name, this is the preferred standard. If substitutions are allowed, they are at the discretion of the Owner and based on performance, suitability, quality, administrative requirements, warranty and other factors deemed important to the Owner.
- F. For the purposes of this Specification, "or approved equal" is implied for all specified, named products.

1.06 CONTRACTOR QUALIFICATIONS AND TRAINING:

- A. The contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems. The Contractor shall at a minimum possess the following qualifications:
 - 1. Possess those licenses/permits required to perform telecommunications installations in the specified jurisdiction.
 - 2. Provide references of the type of installation detailed in this specification.
 - 3. Personnel trained and certified in fiber optic cabling, splicing, termination and testing techniques. Personnel must have experience using a light meter and OTDR.
 - 4. Personnel trained in the installation of pathways and support for housing horizontal and backbone cabling.
 - 5. Personnel knowledgeable in local, state, province and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists

between local or national codes or regulations, the most stringent codes or regulations shall be followed.

6. Be in business a minimum of five (5) continuous years with a Contractor's license in the state where the project is located, and appropriate for the type of work expected herein.
7. Member in good standing of the Certified Installer network associated with the products listed in this Specification and authorized for use in this Project. Contractor must be a member of this installer program before, during, and through completion of the system installation. Supporting documentation will be required as part of the submittal.
8. Maintain a certified RCDD on staff and utilize certified BICSI Installers for this project.

1.07 WARRANTY:

- A. A Limited Lifetime Product & Performance Warranty covering all components, equipment and workmanship shall be provided to the Owner, submitted in writing with system documentation. The warranty period shall begin on the system's first use by the owner.
 1. Horizontal channels shall be completed with end to end solutions, such as the Berk-Tek Leviton Technologies Solutions. Factory-terminated copper and/or fiber optic patch cords from the solutions provider must be used in order to be eligible for the applicable channel performance guarantees.
 2. The Contractor must pre-register the project with the Manufacturer before installation has begun. Following project completion, contractor is responsible for completing all warranty registration procedures on behalf of Owner.
 3. Should the cabling system fail to perform its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the contractor shall promptly make all required corrections without cost to the owner.
- B. Certified Installer shall provide labor, materials, and documentation in accordance with Manufacturer requirements necessary to ensure that the Owner will be furnished with the maximum available Manufacturer's Warranty in force at the time of this project.
- C. The installed structured cabling system shall provide a warranty guaranteeing a minimum channel performance above the ANSI/TIA 568-C requirements for all category-rated solutions in this Specification. See Products section for performance criteria. Standards-compliant channel or permanent link performance tests shall be performed in the field with a Manufacturer-approved certification tester in the appropriate channel or permanent link test configuration.
- D. Necessary documentation for warranty registration shall be provided to the manufacturer by the installer (within 10 days) following 100 percent testing of cables.
 1. Installer shall submit test results to Manufacturer in the certification tester's original software files.
 2. Installer shall ensure that the warranty registration is properly submitted, with all required documentation within 10 days of project completion.
 3. Certified Contractor/Integrator must adhere to the terms and conditions of the respective manufacturer's warranty programs.
- E. Installer shall ensure that the Owner receives the manufacturer issued project warranty certificate within 60 calendar days of warranty registration.

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1.08 BACKBONE SUBSYSTEMS:

- A. 19" racks, cabinets, patch panels, rack mounting kits for switch and hubs, wire management components, and patch cables shall be furnished and installed by Contractor.
- B. Backbone copper and fiber systems form an interconnected infrastructure between MDF, IDF, and zone enclosures, both inside and between buildings. All cable, connectors, panels and support systems shall be installed and tested by contractor.
- C. Typical Fiber backbone will be Singlemode low-water-peak (OS2) fiber optic cable or Laser-Optimized Multimode (OM3) fiber optic cable as noted below and on plan drawings. Singlemode is typically run between buildings and Multimode fiber is run within the building. Singlemode fiber will be terminated on LC connectors using pre-polished connectors or fusion splice pigtails. Multimode fiber may be terminated on LC connectors using pre-polished connectors or fusion splice pigtails, or may be factory pre-terminated onto MTP multi-fiber connectors.
- D. No splicing of cables will be required or allowed between endpoints. Armored cable must be grounded at both ends if run outdoors. With armored fiber, no innerduct will be required. Check plans for clarification or exceptions.

1.09 WORK AREA SUBSYSTEM:

- A. The connection between the information outlet and the station equipment in the work area is provided by the Work Area Subsystem. It consists of cords, outlets, adapters, and other filters/impedance matching devices.

1.010 HORIZONTAL SUBSYSTEM:

- A. The Horizontal Subsystem is the portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunications room/closet. It consists of the telecommunications outlet/connector, the horizontal cables, optional consolidation point, wireless access point cabling, and that portion of the cross-connect in the telecommunications room/closet serving the horizontal cable. Each floor of a building should be served by its own Horizontal Subsystem.

1.011 ADMINISTRATION SUBSYSTEMS:

- A. The Administration Subsystem links the Horizontal Subsystem and the Backbone Subsystem together. It consists of labeling hardware for providing circuit identification and patch cords or cross connect wire used for creating circuit connection at the cross connects.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. Provide complete raceway, outlet boxes and miscellaneous items as required.
- B. Provide minimum 4-¹¹/₁₆" square outlet box at each outlet location with single gang plaster or tile ring and 1.25" conduit to cable tray, backboard, or accessible ceiling or floor space.
- C. Provide a complete data cabling and device system as described herein.

2.02 HORIZONTAL CABLING SYSTEMS:

4 - 27 10 00 Structured Cabling

D. NETWORK DATA CABLES

1. Provide 4-pair, 100-Ohm balanced unshielded twisted pair (UTP) Cables for each data outlet designated.
2. All UTP cables passing through air handling space shall be PLENUM-rated (CMP). Cables not passing through air handling spaces may be PVC (CMR) jacketed. Some buildings will require the use of Plenum cable. The contractor is solely responsible for verifying the construction requirements and installing the correct cable. Failure to provide CMP cable in Plenum required spaces will result in the contractor removing and replacing the cable at their own expense.
3. CAT6A UTP cable shall conform to the following requirements:
 - a. All cables shall be made in the USA of solid annealed copper conductors, 23 AWG, with four individually twisted pairs in a single round cable sheath.
 - b. Characterized to 750 MHz, 250 MHz greater than the standard
 - c. Outer diameter 0.300" (7.6mm), CMP
 - d. Be made by an ISO 9001 and 14001 Certified Manufacturer.
 - e. Channel margin guarantees for ANSI/TIA 568-C.2 CAT6A and ISO/IEC 11801 Class E_A (margin vs. ANSI/TIA-568-C.2 and margin guarantees are for a standard 2-connector channel).

Insertion Loss	3%
NEXT	2 dB
PSNEXT	3 dB
ACR-F (ELFEXT)	5 dB
PSACR-F (PSELFEXT)	6 dB
Return Loss	1 dB
ACR-N	4 dB
PSACR-N	5 dB

Approved Products:

Berk-Tek:

Category 6A LANmark XTP, CMP #11082057 (1000' reel)

Category 6A LANmark XTP, CMR #11082062 (1000' reel)

Category 6 Premium LM2000, CMP # 10163222 (1000' reel)

Category 6 Premium LM2000, CMR # 10167476 (1000' reel)

* Color as noted on drawings/district standard (verify prior to submittal)

E. DATA INFORMATION OUTLETS:

1. COPPER PATCH PANELS

- a. Integrated 110-style patch panels shall exceed requirements for Category 6A described in ANSI/TIA-568-C.2 and Class E_A and Class E component requirements (respectively) as described in ISO/IEC 11801 in a typical standard-density (48 ports per 2RU) configuration.
- b. Integrated 110-style patch panels shall be available in flat or angled styles, 24 ports per RU in an un-staggered horizontal layout.
- c. Modular (unloaded) patch panels shall accept the same Universal jacks as are used at the workstation area outlets. No special "panel jacks" shall be required.
- d. Modular patch panels shall be available in flat, angled, Recessed and recessed angled varieties, in 1RU 24 and 48-port versions or 2RU 48 and 72-port configurations.
- e. Patch panels shall be sized to fit an EIA standard, 19 inch relay rack, and made of 16-gauge steel and powder-coated black with white silkscreened lettering.

Approved Product examples:

Leviton CAT6A 110-style Flat 1RU 24-port Patch Panel, # 6A586-U24
Leviton CAT6A 110-style Angled 2RU 48-port Patch Panel, # 6A9587-U48
Leviton QuickPort® 1RU Flat 48-port Patch Panel, # 49255-Q48

2. CAT6A JACKS: Provide modular type Category 6A information outlets for 23-AWG copper cable. These Category 6A (CAT6A) connectors shall be individual snap-in style, and exceed compliance with TIA/EIA-568-C.2 specifications. The connectors shall comply with the following:
 - a. Be 8-position/ 8 conductor (8P8C, RJ45-style) modular jacks.
 - b. Utilize a universal Keystone-style insertion footprint as the manufacturer's main "flagship" line of products.
 - c. Comply with FCC Part 68; UL listed and CSA Certified. Verified to exceed all channel performance requirements in TIA-568-B.2-10 from 1 MHz to 500MHz to support the IEEE 802.3an standard for 10 Gigabit Ethernet over UTP Cable.
 - d. Each 10G connector is to feature an injection molded Cone of Silence™ technology to eliminate alien crosstalk (AXT).
 - e. Every 10G connector to include polymer springs above the tines ("Retention Force Technology" or similar functionality) to promote return of tines to original position and protect against deformation due to stress of patch cords or inappropriate materials insertion
 - f. Connector shall have Pair Separation Towers on IDC to facilitate quick, easy terminations without a complete untwist of each pair of conductors.
 - g. The connector shall be rear 110-type insulation displacement connectors (IDC) with solder-plated phosphor bronze contacts, configured in a 180° orientation such that the punch down field is in the back, allowing for rear termination.
 - h. The connector shall provide a ledge directly adjacent to the 110-style termination against which the wires can be directly terminated and cut in one action by the installation craftsperson.
 - i. Connector wiring label shall provide installation color codes for both T568A and T568B wiring schemes on separate labels.

Approved Products:

Leviton Atlas-X1 CAT6A QuickPort Module # 61UJK--R*6

Where * = one of 13 colors. See drawings or check with Owner for application.

3. FACEPLATES: Faceplates provide information outlets to the work area. Contractor shall provide and install single gang faceplate kits to allow up to six data or voice jacks as required for all work area outlets, workstation base feeds, and unused telecom backboxes and furniture openings. Faceplates shall:
 - a. Utilize a Quickport ("keystone"-style) footprint to match the approved connectivity manufacturer, and be made by the same manufacturer as the connectors.
 - b. Match colors and materials of the power wiring device plates.
 - c. Support any connectivity media type, including fiber and copper applications.
 - d. Have write-on designation labels for circuit identification together with a clear plastic cover.
 - e. Be available in single-gang and double-gang configurations.
 - f. Have surface-mount boxes and standoff rings available for both single and double gang faceplates.
 - g. Have single-port matching color blank inserts available in packs of 10.
 - h. Shall be stainless steel when installed above accessible ceiling.

Approved Products:

Leviton QuickPort Single-Gang, Plain, # 41080-#xP

Leviton QuickPort Single-Gang with ID Windows, # 42080-#xS
Leviton QuickPort Blank Inserts, pack of 10, # 41084-BxB
Leviton QuickPort Stainless Steel wallphone plate, # 4108W-0SP

Where:

= number of ports: 1, 2, 3, 4, 6

x = color: White (W), Ivory (I), Light Almond (T), Gray (G), Black (E)

Check drawings for requirements

2.03 BACKBONE CABLING SYSTEMS

F. BACKBONE CABLES:

1. GENERAL

- a. The cable route within a building, connecting closet to closet or closet to the equipment room is the Intra-building Backbone Subsystem. It links the Main Distribution Frame (MDF) in the equipment room to Intermediate Distribution Frame (IDF) and Horizontal Cross-connects (HC) in the Telecommunications Room/Closets (TC). It consists of the backbone transmission media between these locations and the associated connecting hardware terminating this media. These fiber optic cables are typically Multimode.
- b. Cables run from building to building in a campus, or from campus to campus are part of the Interbuilding Backbone System. It consists of the backbone transmission media between these locations and the associated connecting hardware terminating these media. These fiber optic cables are typically Singlemode.
- c. Cables allowed for use in the backbone shall support voice, data, video, wireless and building infrastructure applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation. All cables shall conform to ANSI/TIA/EIA-568-C Commercial Building Telecommunications Cabling Standard. These cables include:
 - 1) 4-pair 100-ohm unshielded twisted-pair 100% annealed-copper solid-conductor cables, 100-ohm UTP multi-pair copper cables
 - 2) 50/125 μ m (micron) Laser-Optimized Multi-Mode Fiber (LOMMF) cables (OM3 or better)
 - 3) 8.3 μ m low-water peak singlemode optical fiber cables compliant with ITU-T G.652D (OS2).

2. VOICE COPPER BACKBONE CABLE

- a. Power-Sum Multi-Pair Category 3 cable, 24 AWG solid-copper conductors in 25-pair binder groups to support 10BASE-T, 100BASE-T and Analog Voice communications at 16Mhz.

Approved Products:

Berk-Tek # 10032111, 25-pr CMP, Gray.

Berk-Tek # 10032396, 25-pr CMR, Gray

Other multiples of 25 acceptable (50, 100, 200, 300 pair as required)

3. SINGLEMODE FIBER OPTIC CABLE

- a. Singlemode fiber optical fiber cables shall meet all of the requirements delineated within the specifications of ANSI/TIA/EIA-568-A. Must be a minimum of 12 strands of nominal 8.3 micron optical fiber, and must be appropriate for the environment in which it is installed (Indoor, Indoor/Outdoor, Outside Plant, OFNP or OFNR).

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- b. Fiber optic cables will utilize an interlocking armor outer cover around an integrated Loose-Tube (indoor/outdoor) cable construction.
- c. Loose tube fibers shall utilize a fan-out kit to fit 250 micron fibers into a 900 micron protective sheath when terminating.
- d. See plans and scope of work for total strand count between locations.

Approved Manufacturers

Berk-Tek Adventum Indoor/Outdoor Dry Loose-Tube Plenum cable,
12-strand SM, armored, # LTPK12AB0403
Berk-Tek Adventum Indoor/Outdoor Dry Loose-Tube Plenum cable,
24-strand SM, armored, # LTPK12B024AB0403
Berk-Tek Adventum Indoor/Outdoor Dry Loose-Tube OFNR cable,
12-strand SM, armored, # LTRK12AB0403
Berk-Tek Adventum Indoor/Outdoor Dry Loose-Tube OFNR cable,
24-strand SM, armored, # LTRK12B024AB0403
Leviton 12-fiber, 24" fan-out Kit, # 49887-12S

G. COPPER TERMINATION BLOCKS

1. Provide termination blocks for Category 3 Backbone Cabling Systems that support up to Category 5e applications and facilitate cross-connection using twisted pair wiring.
2. The connecting hardware block shall support the appropriate Category 3 to 5e voice (non-VOIP) applications and facilitate cross-connection and/or inter-connection using cross-connect wire. The cross-connect hardware shall be of 66-type (telephone) AND:
3. The cross-connect shall be Category 5e 110-style wiring bases, mountable to wall or backboard to provide 110 termination capable of supporting voice, security, and Category 5e data applications, including high megabit and shared-sheath applications when used with Category 5e rated cabling.
4. The components shall be UL listed and ANSI/TIA-568-C compliant. Bases shall support 50, 100 or 300 pair densities with provision for ANSI/TIA-606-B compliant labeling. Plastic bases and blocks shall be made of fire-retardant plastic rated UL 94V-0.
5. Cross-connect blocks shall be available in a variety of insulation displacement clips (IDC) with and without tails, and support wire sizes: Solid: Wire Ranges 22-26 AWG (0.64mm - 0.40mm).

Approved Products:

Leviton 110 Connecting Block, 100-pair w/legs # 41AW2-100
Leviton Wire Manager w/legs, # 41A10-HCM

H. FIBER OPTIC ENCLOSURES, PANELS AND TRAYS

1. All Fiber interconnect centers, panels, enclosures and trays (units) shall provide cross-connect, inter-connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.
2. Rack-Mounted, High Density Fiber Interconnect Center: The high density, rack mounted fiber interconnect center shall:
 - a. Fiber enclosure shall be available in 1, 2 and 4RU versions to accommodate termination and splicing of fiber. Enclosure depth shall be 17".
 - b. Enclosure shall feature a sliding tray which removes completely, front or rear, from enclosure to facilitate field terminations and splicing.

- c. Rack-mount enclosure shall have removable transparent hinged doors and slide away covers allow easy access during install and visibility of interior after install.
- d. Fiber Adapter Plates (bulkheads) shall accept SC and LC connectors, MTP® adapters, and plug-n-play MTP modules/cassettes.
- e. Fiber cable management for routing, storage, and protection shall accept patch cords, tight-buffer fiber, and backbone cables. Rear fiber cable management rings shall be stackable and configurable in ¼, ½, or full ring arrangements. Enclosure shall be constructed of 16-gauge steel with a powder-coated black finish and be mountable in a 19" rack or cabinet frame. An optional locking door feature shall be available.
- f. Enclosure shall be available either empty or in custom pre-loaded configurations, with or without locking doors.

Approved Products:

Leviton Opt-X Ultra Rack-Mount 1RU Enclosure, # 5R1UH-S03
Leviton Opt-X Ultra Rack-Mount 2RU Enclosure, # 5R2UH-S06
Leviton Opt-X Ultra Rack-Mount 4RU Enclosure, # 5R4UH-S12
Leviton lock and key # 5L000-KAL
Leviton armored cable ground kit, # DPGRD-KIT

3. FIBER OPTIC WALL-MOUNT ENCLOSURES

- a. The enclosure shall mount on a wall in an 8"x13", 12"x14" or 17"x15" footprint.
- b. Adapters shall be mounted in metal mounting plates and attached to the enclosure using plastic plungers.
- c. There shall be cable entrance ports in the top and bottom of the patch panel on both the distribution and patch sides.
- d. Cable entrance ports are designed with a strain relief post with a slot capable of holding a tie wrap.
- e. The enclosure shall provide strain relief in the form of a grounding lug and multiple tie wrap points.
- f. The enclosure shall have a plastic fiber management ring made of high impact UL 94V-0 rated fire-retardant plastic. This ring shall be stackable and adjustable. A port identification label/card shall be provided.
- g. The enclosure shall be made of 16-gauge steel powder coated black.

Approved Manufacturers

Leviton Wall Mount Fiber Enclosure, 2-panel, split-metal door w/key, # 5W120-00N, or larger size as appropriate.

I. FIBER TERMINATION PRODUCTS

1. FIBER ADAPTER PLATES

- a. Fiber Adapter Plates shall be used to present field-terminated or pre-terminated discrete, single-strand connectors (e.g. LC) to a fiber enclosure panel.
- b. The fiber adapter plate shall be modular and functional for use in either a wall-mount or rack-mount enclosure. The adapter plate shall be provided in LC styles, in 12- or 24-fiber configurations. 12-fiber adapter plates are used to terminate 12-fiber cables, and 24-fiber adapter plates are used to terminate 24-fiber (or greater) cables. Avoid deployment of adapter plates with unused ports at the rear.

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- c. The adapter plate shall be compliant to TIA-568-C.3 (for performance) and respective TIA-604-X (for intermateability) standards. Adapter plates shall use zirconia ceramic sleeves and be offered in standard fiber type colors pursuant to TIA-568-C.3 standards.
- d. LC adapter plates shall be precision-molded in the USA and integrated to eliminate "rattle" and loose fit. All ferrules shall be zirconia-ceramic. Adapter plates shall be offered in standard fiber type colors. Singlemode colors are typically BLUE, Multimode are typically AQUA.

Approved Products:

Leviton Opt-X Fiber Adapter Plate, 12 LC SM Blue, #5F100-2LL

Leviton Opt-X Fiber Adapter Plate, 24 LC SM Blue, #5F100-4LL

Leviton Opt-X Fiber Adapter Plate, 12 LC MM Aqua, #5F100-2QL

Leviton Opt-X Fiber Adapter Plate, 24 LC MM Aqua, #5F100-4QL

2. FIBER CONNECTORS

- a. The fiber optic connector shall meet or exceed the requirements described in ANSI/TIA-568-C.3 and ANSI/TIA-604-3 (LC) Connector Intermateability Standards
- b. Connector shall be pre polished and field installable to eliminate the need for hand polishing, bonding, or epoxy in the field.
- c. Connector shall be provided in LC, single-mode or multimode (laser optimized) configurations, terminated on 250 or 900 µm buffered fiber and/or 2mm or 3 mm jacketed fiber.
- d. Maximum connector insertion loss shall be no greater than 0.5 dB, with an average of 0.1 dB (MM) or 0.2dB (SM). Typical connector return loss shall be 35 dB (multimode) and 56 dB (single mode). All versions shall allow continuity to be verified by use of a visual fault locator (VFL).
- e. Connector shall utilize a precision zirconia ceramic ferrule, and be re-terminable up to 3 times during testing without loss of performance.
- f. Connector shall require the use of a cleaver with a guaranteed maximum cleaving angle of 2 degrees for multimode and 1 degree for singlemode fibers.

Approved Products:

Leviton FastCAM LC Singlemode, # 49991-SLC

Leviton FastCAM LC Multimode, # 49991-LLC

Leviton / Lynx cleaver # 49886-LNX or equal

3. MTP® MODULES FOR PRE-TERMINATED CABLES

- a. 24-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in LC connectors will land on a 24-strand (12 LC Duplex Port) MTP-LC Cassette module and will utilize a 24-strand MTP connector at each end of the trunk. 12-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in LC connectors will land on a 12-strand (6 LC Duplex Port) MTP-LC Cassette module using 12-strand MTP connectors.
- b. 24-strand Multi-Mode Fiber optic MTP-MTP configured trunks which terminate in MTP 40G connectors will land on an MTP - MTP Cassette module with (3) 8-strand MTP connectors on the front. Trunks utilizing 2 or more 24-strand MTP connectors may land on a MTP module displaying (2) 24-strand MTP connectors in the rear, and (6) 8-strand (40G) MTP connectors in the front. Multiple modules may be required if trunk cables are configured with greater strand counts or connectors.
- c. The MTP modules shall meet the following requirements:
 - 1) Insertable directly into fiber enclosure panel openings with a push-pin/grommet latch.

- 2) Rated for Laser Optimized Multi-mode OM3 optical fiber.
- 3) Shall utilize a Red male MTP connection at the rear to designate the 24-strand MTP.
- 4) Shall utilize Method B Polarity.
- 5) Shall require one Core module at one end of a fiber trunk segment, and one Edge module at the second end to maintain correct polarity across the system.
- 6) Core modules will be used at the MDF and Edge modules at the IDF ends of the cable for consistency of design.
- 7) 40G MTP connector housings at front of module shall be Black.

Approved Products:

Leviton Method B polarity, 24-fiber MTP to LC, OM3, Core module
FM-E024CDC0BC
Leviton Method B polarity, 24-fiber MTP to LC, OM3, Edge module
FM-E024CDC0BE
Leviton Method B polarity, 24-fiber MTP to 3x8-fiber MTP, OM3 module
FM-E024NDC0E
Leviton Method B polarity, 2x24-fiber MTP to 6x8-fiber MTP, OM3 module
FM-F048NDC0B

4. SPLICE TRAYS AND CASSETTES

- a. Fiber splice trays shall mount to rear of enclosure for terminating bulk fiber optic cable to factory terminated fiber optic pigtailed.
 - 1) Splice trays shall be offered in mini and high density versions with removable clear covers for viewing and inspection of fibers.
 - 2) Incoming fiber shall be secured utilizing a ratchet action foam rubber padding clamp feature or tie-down points to minimize crushing of fiber.
 - 3) The trays shall accommodate slack management of both single-mode and multimode 250 or 900µm fiber and protection of (up to) 12 or 24 fiber heat shrink style fusion splices.
 - 4) Heat shrink splice sleeves shall be included. Splice tray shall be made by the fiber enclosure manufacturer.
- b. Fiber pigtail fusion splice modules shall mount to front of fiber enclosure for terminating bulk fiber optic cable to factory terminated fiber optic pigtailed, and shall be front-removable.
 - 1) Splice Modules shall be offered in 12- or 24-fiber LC for OS2 (Singlemode) and OM3 (Multimode) fiber types. Construction of module shall be of 14-gauge aluminum for robustness and light weight.
 - 2) Splice Modules shall be pre-loaded and routed with respective 3-meter, color-coded, 12-strand pigtail assembly.
 - 3) Individual pigtailed shall have maximum insertion loss of 0.4 dB and 0.35 dB for OM3 and OS2 fiber types, respectively. Return Loss shall be greater than 25 dB (for OM3), 55 dB (for OS2/UPC), and 60 dB (for OS2/APC).
 - 4) Individual compartments in splice module shall provide slack storage and bend radius protection for incoming backbone fibers, 900 µm tight-buffer fibers, and fusion-spliced fibers. Incoming 250 µm backbone fibers shall be protected by an included braided mesh sleeve. Heat shrink style splice sleeves and tie wraps shall also be included with module.

Approved Products:

Leviton Mini Splice Tray, 12-strand # T5PLS-12F
Leviton High-Density Mini Splice Tray, 24-strand # T5PLS-24F
Leviton LC 12-Fiber pigtail kit, OS2, #UPPLC-KIT

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Leviton LC 12-Fiber pigtail kit, OM3, #5LPLC-KIT

Or

Leviton Opt-X 12-Fiber LC OS2 Splice Module # SPLCS-12L

Leviton Opt-X 24-Fiber LC OS2 Splice Module # SPLCS-24L

Leviton Opt-X 12-Fiber LC OM3 Splice Module # SPLCS-12A

Leviton Opt-X 24-Fiber LC OM3 Splice Module # SPLCS-24A

J. COPPER AND FIBER OPTIC PATCH CORDS

1. CAT6A PATCH CORDS

- a. Provide factory terminated and tested patch cords from the manufacturer of the structured cabling components. Patch cords must meet or exceed all criteria specified in the horizontal cabling standard subsection above.
- b. Copper patch cords shall exhibit the following characteristics:
 - 1) Slimline, integrated snag-less plug design without incorporating the use of a rubber molded boot.
 - 2) A narrow profile for less congestion in higher density applications and a strain relief boot ensures long-term network performance
 - 3) Copper Category 6A patch cords shall be Component-rated per TIA 568-C.2-10 for CAT 6 and CAT6A component performance and Independently tested and verified by Intertek (ETL).
 - 4) Outside diameter of 0.225" (CAT6) or 0.240" (CAT6A).
 - 5) 26 AWG stranded conductors for maximum flexibility
 - 6) CAT6A cord complies with TIA 568-C.2-10 component requirements for connecting hardware from 1 MHz to 500 MHz, ISO 11801 Class E_A, IEEE 802.3an to support 10GBASE-T networks and cULus listed.
 - 7) Available Lengths: 3', 5', 7', 10', 15', or 20'
- c. Provide factory assembled patch cords meeting or exceeding all criteria specified in the horizontal cabling standard subsection above, in the following quantities:
 - 1) (1) 10' CAT 6A patch cable per outlet location/faceplate (drop) for use at the workstation.
 - 2) (1) 5' (average) CAT 6A patch cable per outlet location/faceplate (drop) for use at the network switch in the MDF and IDF.
 - 3) (1) 3' CAT 6A patch cable per outlet location/faceplate (drop) for use at wireless access points.

Approved Products:

Leviton Slimline CAT6A Component-rated Patch Cord, #6AS10-xx*

Leviton Slimline CAT6 Patch Cord, # 6D460-xx*

Where:

xx = Length in Feet

* = color: White (W), Yellow (Y), Red (R), Blue (L), Green (G), Grey (S), Black (E)

2. FIBER JUMPERS AND ARRAY CORDS

- a. Fiber optic LC-LC patch cords, or jumpers, will make LC connections from the rack termination points to the equipment. The jumpers will meet the following requirements:
 - 1) Factory-manufactured using 50/125 μ m Laser Optimized Multi-Mode OM3 optical fiber. Field terminations on fiber jumpers are not acceptable.
 - 2) Shall utilize A-B polarity.
 - 3) Shall exhibit <0.3 dB insertion loss and -25 dB return loss.

- 4) Shall be thin, round, 2-strand 2mm fiber cable with duplex "Uni-boot" reversing polarity LC connector at both ends to minimize congestion at rack and in cable managers.
 - 5) Shall be available in standard lengths of 1, 2, 3, 5 and 10 meters and custom-orderable up to any length of feet or meters
- b. Fiber-Optic MTP-MTP "array cords" shall utilize 8-strand MTP (female) to 8-strand MTP (male) connectors in a 3mm breakout jacket. The array cords will meet the following requirements:
- 1) Array cords shall meet an optical insertion loss not to exceed 0.35 dB per mated connector pair.
 - 2) Array cords shall be available in 1-, 2-, 3-, 5-, and 10-meter lengths.
 - 3) Array cords shall be compliant with TIA-568-C.3 and IEEE 802.3ba and available in UL Riser or Plenum rated cables (Riser is acceptable for in-rack patching)
 - 4) Meets TIA-568-C.3 and IEEE 802.3ba standards (40/100GbE), and adheres to TIA-942 data center design guidelines.
 - 5) Boot color for 8-strand MTP array cords shall be Dark Gray.
 - 6) MTP shall be pinned on one end, unpinned on the other, and utilize Method B polarity.
- c. Provide factory assembled patch cords meeting or exceeding all criteria specified in the horizontal cabling standard subsection above, in the following quantities:
- 1) (2) 2m LC duplex fiber jumper for each backbone cable terminated in IDF and MDF
 - 2) (2) 2m MTP-MTP 8-strand fiber array cord for each backbone cable terminated in MTP ports at IDF or MDF
 - 3) Verify quantities and configuration with owner prior to delivery.

Approved Products:

Leviton LC-LC OM3 Reversing Uniboot duplex jumper, #FPC-M3RR1VVxxxMAB

Leviton LC-LC SM Reversing Uniboot duplex jumper, #FPC-S2RR1VVxxxMAB

Leviton 8-Fiber MTP(f)-MTP(m) Method B OM3 array cord, #5L8MN-BxxM

Where:

xxx or xx = Length in Meters, for example, 010 or 03 as required

K. WIRE MANAGEMENT

1. Provide wiring spindles and channels as necessary to allow neat bundling of all wire and cable on backboard. Provide wiring channel (horizontal) above and/or below each termination block or patch panel, or on the side (vertical) as appropriate. Provide wiring channels by same manufacturer of termination blocks or patch panels. Provide nylon or Velcro type ties for all cables at telephone backboard not run in conduit or channels.
2. Provide 1RU ring-style horizontal wire managers between every 2 patch panels as space allows. Provide 2RU horizontal wire manager between the Orange and Blue sets of patch panels if in the same rack, and above and below each similarly-apportioned bank of patch panels.
 - a. Cable managers shall be flat, open ring style.
 - b. Do not coil or wind patch cords inside ring-style wire managers.
 - c. Use recessed flat wire manager as needed within enclosed cabinets to route patch cords to opposite sides, where the rings of the flat wire managers would interfere with cabinet door closure.

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Approved Products:

Leviton Horizontal manager, 1RU, # 49253-LPM

Leviton Horizontal manager, 2RU, # 49253-BCM

Leviton Recessed Flat Horizontal manager, 1RU, # 49253-RCM

3. Provide full height, front-and-rear, 8" wide Vertical Wire Managers at the side of and between each 2-post and/or 4-post termination rack or frame. If space will not allow, the 5" wide wire manager may be substituted at row ends only, leaving the 8" vertical wire manager between each rack. Owner approval in writing is required prior to this substitution.
 - a. The vertical cable management system shall be cULus listed, PCI rated for 94V-O, ABS rated for UL94HB, and compliant with ANSI/TIA/EIA 568-B standards.
 - b. Mounting hardware shall be included to insure the proper installation to infrastructure. It shall mount onto a standard TIA/EIA recognized equipment rack.
 - c. The management system shall offer an assortment of accessories, including a bend radius slack loop organizer, cable retainers, and shall accommodate top, bottom, side and pass-through cable routing. Dual hinged, cable concealing covers shall be included.

Approved Products:

Leviton Vertical 80"L x 8"W x 8"D channel, black cover, #8980L-VFR

4. For enclosed cabinets, provide horizontal wire management as specified above and vertical or integrated vertical wire management as described below, pertinent to the cabinet manufacturer.

L. Power Distribution Units (PDU)

1. Provide (2) vertical PDU per rack or wall cabinet. Unswitched, non-surge suppressed. 30" length for wall cabinets and 48" for floor-mounted cabinets.
2. Utilize plug and receptacle style appropriate for installation circuits and equipment interfaces.

Approved Products

Leviton P1000 series # P1042-10L

Leviton P1000 series # P1044-10L

M. Equipment and Ladder Rack System:

- A. UL listed Chatsworth 19"W x 84"H x 15" D 45 RMU Aluminum 2 post rack P.N. 55053-703
- B. Ladder rack to wall support, Chatsworth Wall Angle Support Kit
P.N. 11421-712
- C. Rack to runway support Chatsworth mounting plate P.N. 10595-712
- D. Ladder rack support system, Chatsworth Universal Cable Runway P.N. 10250-712
- E. Straight through ladder rack splice, Chatsworth Butt-Splice Kit P.N. 11301-701
- F. Ladder rack junction splice, Chatsworth Junction Splice Kit P.N. 11302-702
- G. Ladder rack protective end caps, Chatsworth Protective Rubber End Caps
P.N.10642-001
- H. Wall support for cable runway Chatsworth Triangular Support Bracket P.N. 11312-712
- I. Provide two single sided equipment shelves or each rack installed, Chatsworth P.N. 40074-700.

- J. Equipment rack bonding material Chatsworth Green Ground Jumper P.N. 40159-009 and Chatsworth Green Cable Runway Ground Strap Kit P.N. 40164-001

N. LABELING:

- A. The contractor shall provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels shall be of high quality that will endure heat, water, and time.
- B. Shall meet the legibility, defacement, exposure, and adhesion requirements of UL 969.
- C. Shall be pre-printed using a mechanical means of printing.
- D. Where used for cable marking, provide vinyl substrate with a white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable. The cable marking shall be immediately visible and within two inches from termination point.
- E. Where insert type labels are used, provide clear plastic cover over label.
- F. Copper patch panel labeling shall be completed with adhesive labeling kit specifically designed for the panel, Leviton 49257-QHD.
- G. Labeling P-touch font size 4MM bold, black on White, 3/8" labeling tape on all work stations, panels and devices.
- H. A round Avery label green in color Product Number: 5463 and a station label utilizing the same font size as on work station face plate must be installed on ceiling grid below each wireless cable location for identification. See type "D" Wireless Location Detail.
- I. Labels shall be numbered consecutively and separate for each type of use. Refer to Work Station Details for additional information.
- J. The contractor shall develop and submit for approval a labeling scheme for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. Labeling shall conform to the owner's Labeling Grammar and the TIA/EIA-606A standard.

K. CAT6 Labeling:

1. IDF side labeling should follow RM.(Room number).(X port number) example RM01.1
2. Station side cabling should follow IDF(Letter).RM.(Room number).(X port number) example IDF-A.RM01.1
3. IDF side WAP/Bell Locations shall be labeled RM(Room number).(W for wireless/B for bell) example RM01.W
4. Station side WAP/Bell Locations shall be labeled IDF.(Letter).RM(Room number). (W for wireless / B for Bell) example IDF-A.RM01.W

PART 3 - EXECUTION

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3.01 INSTALLATION OF TELEPHONE/DATA SYSTEM:

- A. Install raceway and cable system and specified equipment as indicated to comply with NEC and recognized industry practices.

- B. **PRE-INSTALLATION CONFERENCE:**
 - 1. Schedule a conference a minimum of five calendar days prior to beginning work of this section.
 - 2. Agenda: Clarify questions related to work to be performed, scheduling, coordination, etc.
 - 3. Attendance: Communications system installer, General Contractor, Owners Representatives and any additional parties affected by work of this section.
 - 4. Copy of Manufacturer warranty pre-application, RCDD qualifications, and other material not include in submittals will be provided by Contractor at this time.

- C. **WARRANTY:**
 - 1. A lifetime performance warranty covering all components, equipment and workmanship shall be submitted in writing with system documentation. The warranty period shall begin on the systems first use by the Owner.
 - 2. The project must be pre-registered with Manufacturer before installation has begun.
 - 3. Should the cabling system fail to perform within its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the Contractor shall promptly make all required corrections without cost to Owner.

- D. **PATHWAYS AND TOPOLOGY:**
 - 1. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.
 - 2. Provide NEC-sized pullboxes for any run greater than 100 feet, or with more than two ninety-degree bends.
 - 3. Maintain a distance of at least 12 inches from all power conduits and cables, and 6 inches from all fluorescent lighting fixtures. Do not install power feeders 100 amps or greater above or within 5 feet of telecommunications backboard. Do not install telecommunications conduits above power panels or switchboards.
 - 4. The backbone subsystem shall include cable installed in a vertical manner between floor telecommunications room/closets (TCs or IDFs) and the main or intermediate cross-connect in a multi-story building and cable installed horizontally between telecommunications room/closets and the main or intermediate cross-connect in a long single story building.
 - 5. Unless otherwise recommended by the Owner, all fiber cables will be encased in interlocking armor. All fibers will be terminated in the Telecom Rooms or Cabinets in new fiber enclosures equipped with sufficient ports, slack storage space and splice trays if required to terminate and secure all fibers.

6. Adequate riser sleeve/slot space shall be available with the ability to ingress the area at a later date in all Telecommunications rooms/closets, such that no drilling of additional sleeves/slots is necessary.
7. The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each telecommunications room/closet. An intermediate cross-connect may be present between the main cross-connect and the horizontal cross-connect. This is known as a hierarchical star topology.
8. Backbone pathways shall be installed or selected such that the minimum bend radius of backbone cables is kept within manufacturer specifications both during and after installation.
9. Do not run fiber cables in conduits which are less than 2" in diameter.
10. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.
11. The combined length of jumpers, or patch cords and equipment cables in the telecommunications room/closet and the work area shall not exceed 10m (33 ft).
12. Horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation.
13. For voice or data applications, 4-pair UTP or fiber optic cables shall be run using a star topology from the telecommunications room/closet serving that floor to every individual information outlet.
14. The Contractor shall observe the bending radius and pulling strength requirements of the 4-pair UTP and fiber optic cable during handling and installation.
15. Each run of UTP cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall not contain splices.
16. In a false ceiling environment, a minimum of 3 inches (75 mm) shall be observed between the cable supports and the false ceiling.
17. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.
18. J-hooks shall be provided for all suspended cable, at a semi-irregular spacing not to exceed 5 feet between supports.
19. Install $\frac{3}{4}$ " x 4' x 8' fire-rated plywood across all walls in telecom rooms, from 6" AFF to 8'-6" AFF. Coat with 2 coats of white paint. Do not paint over fire rating stamp.
20. Contractor shall firestop all used pathways which enter or leave the telecom rooms via conduit, cable tray or slot. Contractor is responsible for installing sleeves at each wall or partition penetration, and firestopping all fire-rated penetrations. Intumescent caulk shall be applied around the outside of each sleeve, and intumescent putty inside the sleeve or conduits around the cables. Appropriate fill ratios must be followed when penetrating fire rated walls.

E. GROUNDING:

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1. All grounding / earthing and bonding shall be done to applicable codes, standards and regulations.
2. Telecom Contractor shall bond and ground all telecom room metals. Telecom Contractor shall provide and install TIA-rated Telecommunications Grounding Busbar (TGB) at all MDF and IDF locations, and an in-cabinet grounding busbar at each remote wall-mounted cabinet or telecom enclosure. All ground lugs shall be 2-hole make-up.
3. Electrician will provide connection between TGB and building ground; Telecom contractor (if separate, otherwise electrician) will provide a busbar and ground all equipment and telecom metals to the busbar.
4. Telecom installer will ground and bond all armored and/or shielded cables, racks, cabinets, cable tray, ladder racking, and shielded panels to telecom grounding busbar.
5. All grounding and bonding conductors shall be copper and may be insulated. When conductors are insulated, the sheath shall be green or marked with a distinctive green color, and shall be listed for the application. The minimum bonding conductor size shall be #6 AWG.
6. The Telecommunications Ground Busbar (TGB) shall be dedicated and pre-drilled copper busbar provided with holes for use with standard sized lugs. This busbar shall have minimum dimensions of .25 inch thick, 4 inches wide, and be variable in length.
7. Two-hole compression ground lugs shall be Chatsworth 40162-901, 40162-904, 40162-909, and 40162-911, or equal, based on the size of the copper conductor to be terminated.
8. All low voltage systems in this project shall be grounded and bonded.

F. CABLES AND TERMINATIONS:

1. Check plans and symbology for final determination of faceplate constitution or consult with Owner prior to bid.
2. Install additional cables as indicated on the drawings. Do not exceed manufacturers' recommendations for maximum allowable pulling tension, side wall pressure or minimum bending radius. Use pulling compound as recommended by cabling manufacturer.
3. Install CAT6A cables for Wireless Access Points and cameras, and CAT6 everywhere else unless otherwise noted.
4. Provide a full-size service loop (at least once around the inside edge of the box) in each J-box in the communications system.
5. Install all cable in plenum spaces with J-hooks of at least 1" in width to disperse the weight on the bottom cables. Homerun all cable to nearest TR Cabinet.
6. Coordinate with EIA/TIA 569 tables 4.4-1 and 4.4-2 for conduit and splice box sizing.
7. Install modular jacks at all outlets shown; one data jack for each data cable at each faceplate or termination point. Install additional cables and modular jacks as indicated on the drawings.
8. Terminate cables at each jack location and at termination board or patch panel. Follow industry guidelines and manufacturers' recommendations and procedures as required. All termination hardware shall be rated to exceed Category 6 specifications as specified above.

9. Label and identify each outlet and cable for data circuits. Label at outlet end and at termination board or patch panel with matching designations.
10. Provide data outlets in surface raceway at 26" on center unless otherwise indicated.

3.02 TERMINAL BLOCKS AND PATCH PANELS:

- A. Arrange all terminal blocks in a manner that allows natural wiring progression and minimizes crossing of wires.

3.03 PATCH CORDS:

- A. Contractor to provide fiber and copper patch cords in quantities as described as outlined above in section 2.4.G. Neatly install (minimum) one 3', 5' or 7' CAT6 or CAT6A patch cord (as appropriate to reduce unnecessary length in wire managers) at the equipment cabinet between patch panel and owner-provided switches for each classroom and computer location. Dress and bundle patch cords as appropriate for final installation. Provide unused patch cables to Owner upon completion of project.
- B. Patch cables and fiber optic jumpers must be supplied and installed by the vendor for all terminated data drops, between network switches, building hubs, etc. so that building-wide networking will be operational once all installation is complete.
- C. All fiber patch cords and required workstation/equipment patch cords not installed shall be provided in hand to Owners Representative prior to project closeout.

3.04 LABELING:

- A. Provide labels appropriate for all components supplied and installed.
- B. Each faceplate, cable or data outlet (drop) will be numbered with a unique identifier based on coordination with Owner prior to labeling. Contractor must present labeling system for approval, with all shop drawings, prior to start of construction.

3.05 TESTING:

- A. Test all equipment and each outlet, horizontal cable, termination block, patch cords, etc. to verify compliance with requirements. Testing shall consist of attenuation and NEXT across all splices and devices installed in the field and shall meet latest requirements of EIA/TIA. Re-terminate any cable or connection found to be defective.
- B. Tester is to be configured with the specific cable installed, and the Permanent Link test will be performed according to the CAT6A standard methodology. All parameters must exhibit a PASS test result prior to project completion. PASS*, FAIL* or FAIL test results will not be accepted.
- C. Repair and resolve any shortcomings in the test results. Mitigation efforts may require re-termination or replacement of the jack, outlet or cable. Repairs or attempts to resolve test failures will be completed solely at the expense of the Contractor.
- D. Provide test results to Manufacturer and Owner representative in native Tester format. Upon request, provide a copy of the tester software and license, if needed, at no charge to Owner representative.

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- E. Include PDF of full test results, summary index in electronic format on CD or memory stick in the O&M package upon project completion.

Approved Tester Products:

Fluke DTX or VERSIV platform Cable Certification testers

Linkware Record Management Software

3.06 PROJECT CLOSEOUT:

- A. Operating and maintenance manuals shall be submitted prior to testing of the system. A total of (4) manuals shall be delivered to the Owner. Manuals shall include all service, installation, and programming information.
- B. Provide a full set of "as-built" (redline) drawings in AutoCAD DWG and PDF format. Drawings to depict final location and drop/cable identification numbers and labels which match the test reports. Include (1) hard copy paper format of all as-builts in 30"x42" size or equivalent.
- C. Contractor to provide all warranty information to Leviton for processing. Leviton will send warranty document direct to Owner.

3.07 TRAINING:

- A. Provide four (8) hours training on the operation and installation of the data system, at job site, at no cost to owner.

END OF SECTION

SECTION 275116

INTERCOM, PUBLIC ADDRESS, CLOCK SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Refer to the General Conditions and all other Section of Division.

1.02 DESCRIPTION OF WORK

- A. Furnish and install all labor, materials, equipment, tools, transportation, supervision, services required to provide and leave ready for operation an extension of the existing intercom , P.A. & clock system. The contractor shall include all materials and/or equipment necessary to make a complete working installation. The electrical work shall include, but is not limited to the following:
 - 1. Intercom, public address speakers handsets, head end equipment, wiring and connections as indicated on drawings to extend existing system to new relocatables.
 - 2. Clocks and wiring to extend existing clock system to new relocatables, as indicated on drawings.
- B. Related work included in other Sections:
 - 1. Section 260500, Electrical General Provisions, applies all work in this Section.
 - 2. Basic Construction Materials and Methods: Section 260526.
 - 3. Grounding: Section 260526.
- C. Complete installation and wiring of each device. The systems shall include outlet boxes, wiring devices, signaling facilities, and other items as specified.
- D. Provide all incidental work and materials involved in installation of the signal equipment including carpentry or structural work for support of junction boxes, conduits, control panels, outlets, etc.
- E. The existing intercom console is located in the Administration Building #1.
- F. Contractor shall verify existing clocks and speaker wiring, to ensure compatibility. If wiring is not compatible, new shall be installed.
- G. Cut and patch walls as required for new devices.

1.03 SUPERVISION AND QUALITY OF WORK

- A. The Contractor shall supervise the work of this section, personally, or through an authorized and competent representative.
- B. All material and equipment shall be installed in a neat manner. Any material or equipment not installed in the manner described, shall upon the order of the Architect, Engineer or District be removed and replaced in satisfactory manner. No additional expense shall be allowed to repair work required.

- C. The Contractor shall carefully study and compare all drawings, specifications and other instructions and shall at once report, prior to bid, to the Engineer via the Architect any error, inconsistency or omission that may be discovered.

PART 2 - PRODUCTS

2.01 GENERAL DESIGN REQUIREMENTS FOR CLOCK AND COMMUNICATION

- A. Main Console:
 - 1. The main console is existing.
- B. Classroom Speakers:
 - 1. Match existing
- C. Classroom Speaker Back Box:
 - 1. Match existing
- D. Clock:
 - 1. Match existing

2.02 CONDUCTORS

- A. All cables and wires shall be Copper and shall be installed in raceways per C.E.C. Code. All conductors and wires shall be new when delivered to the job site in unbroken packages, with the manufacturer's name and voltage class that shall be plainly indicated on cables and wires.
- B. All cables and wires shall be National, Simplex, General Electric, General Cable, West Penn or approved equal. All conductors installed in underground conduit shall be type "THWN" or UL listed for wet location or direct burial.
- C. Signal Conductors to each device if existing is not compatible shall be as follows:
 - 1. Speaker and handset wire shall be as noted on drawings.
 - 2. Clock wire shall be as noted on drawings.

PART 3 - EXECUTION

3.01 GROUNDING

- A. The Contractor shall provide all necessary grounding for the entire system in accordance with and required by the National Electric Code, and the State of California "Safety Orders".

3.02 TEST AND ADJUSTING

- A. The Contractor shall furnish all required test instruments and equipment. Each piece of equipment and the entire systems shall be adjusted and readjusted to insure proper function of all equipment, elimination of noise, and vibration and left improper operating condition.

3.03 ACCEPTANCE

- A. Before the work shall be accepted, the Electrical Contractor shall demonstrate to the District and the Engineer that the entire installation is complete and in proper operating condition, and the Contract has been properly and fully executed.
- B. Upon acceptance of the work, the Contractor shall deliver to the District a written guarantee to the effect that all parts of the work, including all individual items of equipment and materials and the systems as a whole, shall be free from defects for a period of one year. Upon proper notice, the Contractor shall make good, at their expense any defect that develops or becomes apparent during this period.

END OF SECTION

SECTION 281600

INTRUSION ALARM SYSTEM

PART 1 - GENERAL

1.01. Description of Work:

- A. Furnish and install all materials and equipment including all required equipment, panels, raceways, conductors and connections, and provide all labor required and necessary to complete the work shown on the drawings and/or specified in all Sections of Division 26 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete intrusion alarm system installation including all accessories and appurtenances required for testing the systems. It is the intent of the drawings and specifications that all systems will be complete, and ready for operation. No extra charge will be paid for furnishing items required by regulations, but not specified herein, or on drawings.
- B. [The contractor shall include all costs to de-commission the existing system before any new construction can start. The [District] [Owner] shall be advised in writing the date as to when the existing system will be de-commissioned. The contractor's scope of work shall not degrade any function or operation of the remaining site intrusion alarm system.]

1.02 Related Work:

- A. Division 00 General Conditions, Division 01 General Requirements.
- B. See the following specification sections for work related to the work in this section.
 - 1. All other sections of Division 26.
 - 2. All other sections of Division 27.

1.03 Submittals:

- A. In accordance with Division 26.
- B. Submit the following items:
 - 1. Manufacturer's Catalog Data: Manufacturer's original catalog cuts and original description of data of all material and equipment with sufficient information provided so that the exact function of each device is known. Each item supplied shall be clearly identified.
 - 2. Battery Calculations - Verify that battery capacity exceeds supervisory and alarm power requirements by a minimum of 20%.
 - 3. Floor plan of the point to point connections.
 - 4. Diagram of the power circuitry.
 - 5. Riser diagram.

1.04 Quality Assurance:

- A. Installer: The installation firm shall be an established communications and electronics contractor with a current California C-7 license and at least 5 years successful installation experience of products utilizing integrated intrusion systems and equipment specific to that required for this project. Provide proof of license to [District] [Owner].

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- B. All materials, unless otherwise specified, shall be new, and free from any defects. All items of equipment including wire and cable shall be designed by the manufacturer unless otherwise specified, shall function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.
- C. The Contractor shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The contractor shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.
- D. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

1.05 Warranties:

- A. The contractor shall warrant all equipment and wiring free from inherent mechanical and electrical defect for one year (365 days) from the date of final acceptance. The contractor shall, without additional expense to the owner, replace, in a timely manner, any defective materials or equipment provided by him under this contract within the warranty period.

PART 2 – PRODUCTS

2.01 Intrusion Alarm Control Panel: Contractor shall verify all part numbers are the most current and provide most current products at no additional cost to the [Owner] [District].

- A. Control Panel: Enclosure complete with (2) Bosch DX4020 Conettix Ethernet network and Power Sonic PS-1270 12V 7AH battery. Bosch D9412GV2-C with an additional Bosch D8103 & D101 enclosure, lock and key.
- B. Enclosure to include sufficient 8-point expanders to support homerun cables to each device. Bosch D8128D Octopopit.

2.02 Power Supply

- A. 12 VDC, 5 amp uninterruptible power supply with multi-regulator and battery charger in vented locking 11"H x 15"W x 4"D cabinet. AlarmSaf AS/PLS-12050-B03-UL.

2.03 Motion Detectors

- A. Wall mounted passive infrared type. Bosch DS840 with gimble mount B335-3.

2.04 Exterior Bell

- A. Amesco ABB-1014 to match site standard.

2.05 Key Pads

- A. Wall mounted alarm set/disable keypad with illuminated 16-character vacuum fluorescent display and sounder. Off-white case. Bosch D1255.

2.06 Cable:

- A. #22/4 Conductor cable. West Penn 25241.
- B. #18/4 Conductor cable. West Penn 25244.

- C. #89-610 Barrier Strips for consolidation of power wires at the panel end. Ideal 89 series.
- D. Superior Essex 66-272-3B CAT 6+ data cable grey in color. 2 cables from the Intrusion panel shall be terminated on the designated rack at the nearest IDF room.
- E. All cable run outdoors or underground shall be U.L. listed type for such locations.
- F. All cabling in plenum rated areas shall be plenum rated.

PART 3 – EXECUTION

3.01 General

- A. All wiring in walls and hard ceilings shall be installed in conduit. Exposed wiring installed concealed above suspended ceilings is acceptable. Exposed wiring shall be supported on rings or J hooks not to exceed 48 inches on center. Cable sag shall not exceed more than 12” max. Separation of a minimum of 4” is required between low voltage systems throughout the cable run.
- B. Each device shall have a homerun from the device to the security panel. No daisy chaining of power or alarm circuit wiring is permitted.
- C. End-of-line resistors shall be installed at the device end, not at the panel end.
- D. All devices shall be labeled and each end of the device. All cables are to be labeled with a p-touch labeler on both ends.
- E. All point assignments shall be coordinated and approved by the [District's] [Owner's] IT personnel prior to termination of device cabling at panel end.

3.02 Tests:

A. Field Inspection and Test:

1. Before final acceptance of the work, pre-test system to demonstrate compliance with the contract requirements. System shall be subjected to complete functional and operational tests, including tests in place of each motion sensor.
2. Perform the field inspection and test in the presence of the manufacturer's representative, the owner's representative and Project Inspector of Record (IOR).
3. Test equipment: It shall be the responsibility of the installing Contractor to furnish tools, instruments, and materials required for a thorough test of the system.

3.03 Start Up: Assist:

- A. Contractor shall assist [Owner] [District] with system start up, for a complete and operational system. Provide sixteen (8) hours minimum system training. The Contractor shall provide (2) copies of manufacturer's literature.
- B. Contractor shall provide an additional (8) hours of assistance, at the site, 30 days after initial systems training.

3.04 Project Closeout:

- A. As Built Drawings:

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1. Provide a complete set (full size scalable) of reproducible "as-built" and AutoCAD format drawings showing installed wiring, color coding, and wire tag notations for exact locations of all installed equipment, specific interconnections between all equipment, and internal wiring of the equipment upon completion of system.
- B. Operating and Instruction Manuals:
1. Operating and Instruction manuals shall be submitted prior to testing of the system. Four complete sets of operation and instructions manuals shall be delivered to the owner upon request.
 2. Complete, accurate, step-by-step testing instructions giving recommended and required testing frequency of all equipment, methods for testing each individual piece of equipment, and troubleshooting manual explaining how to test the preliminary internal parts or each piece of equipment shall be delivered upon completion of the system.
- C. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:
1. Instructions on replacing any components of the system, including internal parts.
 2. Instructions on periodic cleaning and adjustment of equipment with a schedule of these functions.
 3. A complete list of all equipment and components with information as to the address and telephone number of both the manufacturer and local supplier of each item.
 4. User operating instructions shall be provided prominently displayed on a separate sheet located next to the control unit.

END OF SECTION

SECTION 28 31 00

FIRE ALARM/VOICE EVACUATION SYSTEM

PART 1 - GENERAL

1.01 Description of Work:

- A. Furnish and install all materials and equipment including all required equipment, panels, raceways, conductors and connections, and provide all labor required and necessary to complete the work shown on the drawings and/or specified in all Sections of Division 26 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete addressable fire alarm installation including all accessories and appurtenances required for testing the systems. It is in the intent of the drawings and specifications that all systems will be complete, and ready for operation. No extra charge will be paid for furnishing items required by regulations, but not specified herein, or on drawings.
- B. Fire Alarm system shall include a main fire alarm control panel, digital communicator for backup phone communication, a remote annunciator[s] and all devices, wiring, etc as indicated on the plans.
- C. The contractor shall include all costs to de-commission the existing system components from existing areas to be demolished before any new construction can start. The District School District shall be advised in writing the date as to when the existing system will be de-commissioned. The contractor scope of work shall not degrade any function or operation of the remaining site fire alarm system.

1.02 Related Work:

- A. Division 26 General Requirements.
- B. See the following specification sections for work related to the work in this section.
 - 1. All other sections of Division 26.

1.03 Codes and Standards:

- A. Devices and equipment for fire alarm systems shall be U.L. listed.
- B. UL 864 Control Units, Fire Protective Signaling Systems.
- C. Devices and equipment for fire alarm system shall be listed by the California State Fire Marshal for the specific purpose the device or equipment is used.
- D. Work and material shall be in compliance with and according to the requirements of the latest version of the following standards and codes:
 - 1. California Fire Code (CFC) based on the International Fire Code (IFC) with California Amendments.

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2. California Building Code (CBC) based on the International Building Code (IBC) with California Amendments.
3. California Electric Code (CEC) based on the National Electric Code (NEC) and California Amendments.
4. California Mechanical Code (CMC) based on the Uniform Mechanical Code (UMC) and California Amendments.
5. California Plumbing Code (CPC) based on the Uniform Plumbing Code (UPC) and California Amendments.
6. Title 19 C.C.R., Public Safety, State Fire Marshals Regulations.
7. NFPA 72, National Fire Alarm and Signaling Code.

1.04 Submittals:

- A. In accordance with Division 26.
- B. Submit the following items:
 1. Manufacturer's Catalog Data: Manufacturer's original catalog cuts and original description of data of all material and equipment with sufficient information provided so that the exact function of each device is known. Each item supplied shall be clearly identified including both U.L. number and a copy of the State Fire Marshal's listing.
- C. Description of conductors to be used with a statement that all wire shall be in conduit. Where accessible ceiling occurs, plenum rated wire on J-hooks is acceptable.

1.05 Quality Assurance:

- A. Installer: The installation firm shall be an established communications and electronics contractor with at least 10 years successful installation experience of products utilizing integrated communications systems and equipment specific to that required for this project. Only California Certified fire alarm technicians or California Certified electrician shall be used to install the fire alarm system. Provide proof to District that all employees are California Certified to install the fire alarm system.
- B. All materials, unless otherwise specified, shall be new, and free from any defects. All items of equipment including wire and cable shall be designed by the manufacturer unless otherwise specified, shall function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.
- C. The Contractor shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The contractor shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

- D. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

1.06 Warranties:

- A. The contractor shall warrant all equipment and wiring free from inherent mechanical and electrical defect for one year (365 days) from the date of final acceptance. The contractor shall without additional expense to the School District, replace any defective materials or equipment provided by him under this contract within the warranty period.

PART 2 - PRODUCTS

2.01 System Description

- A. The contractor shall furnish and install a complete 24 VDC, electrically supervised, addressable analog, microprocessor-based fire alarm control panel as specified herein. The fire alarm system shall include but not be limited to all control equipment, power supply, initiating devices, audible and visual indicating appliances as appropriate, conduit, wiring, fittings, and all other accessories necessary to provide a complete and operable system.

B. General System Operation:

1. When an alarm occurs on a zone the control panel indicates the alarm condition until manually reset.
2. An alarm may be acknowledged by actuating the "ACKNOWLEDGE" switch. This shall silence the control panel buzzer, and change the "SYSTEM ALARM" LED and the individual zone LED from flashing to steadily lit.
3. All alarm signals may be silenced by actuating the "SILENCE" switch. This shall steadily illuminate the "SIGNAL SILENCE" LED. If a subsequent alarm is activated, the alarm signal shall "resound" until again silenced. Once silenced, all alarm signals may be restored again by activating the "SILENCE" switch. Waterflow zones shall be non-silenceable.
4. If the microprocessor fails, the system shall execute a default signaling program. This program will enable the panel to sound the audible signals and summon the Fire Department. In addition, a yellow "DEGRADE" LED shall light to indicate the programming failure. Inability of the system to sound signals or summon the fire department during microprocessor failure shall not be acceptable.

C. Alarm Operation:

1. Operation of a manual pull station or automatic activation of any smoke detector, heat detector, or water flow switch zone shall cause the FACP to:
2. Sound all indicating appliances in a temporal pattern.
3. Flash all strobes.
4. Shut down all air handling units as specified herein.

5. Flash the panel "System Alarm" LED and pulse a panel audible signal.
6. Display a description of the specific analog/addressable device in alarm via an 80-character alpha-numeric display.
7. Display a description of the specific analog/Addressable device in alarm on the administrations Remote 80-character Annunciators.
8. Notify the Fire Department via the UDACT [and AES-Intellinet Radio].

D. Electrical Supervision:

1. Each initiating and signal circuit shall be electronically supervised for opens, shorts, and ground faults in the wiring. The occurrence of any fault shall activate the system trouble circuitry but shall not interfere with the proper operation of any circuit that does not have a fault connection.
2. Each initiating circuit shall be capable of being wired using Class "B" (Style B) supervised circuits (a break or ground fault in any conductor shall be reported as a trouble condition) at no extra cost.

E. Normal Power Supply:

1. Connections to the normal electrical service shall be on a dedicated branch circuit in accordance with the California Electrical Code (CEC) the circuit and connections shall be mechanically protected. The circuit disconnecting means shall be accessible only to authorized personnel and shall be clearly marked "FIRE ALARM CIRCUIT CONTROL."

2.02 Fire Alarm Control Panel:

- A. The FACP shall be new Notifier NFS2-3030 (with Emergency Voice Evacuation Digital Voice Command):
1. Auxiliary SPDT alarm and trouble dry contacts.
 2. Auxiliary circuitry in the control panel to operate remote relays for control of air handling equipment.
 3. A solid-state power transfer circuit that shall switch to standby power automatically and instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions).
 4. This electronic circuit shall allow the batteries to be effectively "floated" on the operating system to avoid upsetting normal microprocessor operation and minimize resultant nuisance troubles and /or alarms. This circuit shall be physically isolated from the power supply to facilitate service.
 5. A ground fault detector to detect positive or negative grounds on the initiating circuits, signal circuits, power circuits, and telephone line circuit. A ground fault LED shall be

illuminates and shall operate the general trouble devices as specified herein but shall not cause an alarm to be sounded.

6. Short circuit LED's for all notification appliance circuits shall be a standard feature of the fire alarm control panel. Each circuit shall be monitors for short circuits and shall have a distinct LED for visual indication of the circuit.
7. Operating trouble devices as specified herein but shall not cause an alarm to be sounded.
8. Individual circuit fuses shall be provided from the following: smoke detector (resettable) power, main power supply, battery standby power, and auxiliary (non-resettable) output.
9. A common reset and lamp test switch, labeled "RESET/LAMP TEST" shall be provided to reset the system.
10. Circuitry shall be provided in the control panel to permit transmission of trouble alarm signals over leased or privately owned telephone cables to a remote receiving panel. There shall be a remote disconnect switch to allow testing of the fire alarm signal without transmitting an alarm signal to the central station.

2.03 System Cabinet:

- A. The system cabinet shall be surface mounted with a texture finish and shall be made of these three parts: backbox, backplate, and door.
- B. The cabinet shall be of dead-front construction and 16-gauge cold rolled steel. The door lock system shall consist of two locks which will accept two different keys. One "OPER" key shall allow dead front access to the module display for all operator functions while one "TECH" key shall allow access to all pane electronics without further dismantling of the cabinet, control unit, or wiring.

2.04 Power Supply:

- A. All AC line connections shall be isolated from the power supply unit and transformer by means of a cable-connected AC Unit per U.L. 864.
- B. The 120 VAC main power shall be transformer converted to low voltage, rectified and filters 24 VDC nominal for system operation and to eliminate the possibility of line voltage being present on any internal panel components. The power supply shall be integral, filtered, nominal 24 VDC at 5 Amps, and comply with U.L. 864.
- C. Primary Power outputs shall be as follows:
 1. A green LED on the power supply card shall indicate the presence of primary power.
- D. Power Supply outputs shall be as follows:
 1. 24 VDC Non-Resettable, 1.75 Amps max., Power Limited.
 2. 24 VDC Resettable, 1.75 Amps max., Power Limited.

E. NOTE: maximum combined output for both is 3.0 Amp.

2.05 Battery Charger:

- A. The power supply shall contain a supervised and fused battery charger with a maximum average charging current of 1.0 Amp (this current shall be sufficient to maintain the system batteries at full charge).
- B. If the system loses AC power, a System Trouble shall occur.
- C. The battery charger shall be capable of charging up to 34 ampere/hour capacity, lead-acid batteries. If batteries are mounted within the control panel enclosure provide a battery shelf.

2.06 Detection Circuits:

- A. Each Analog Detection Loop Unit shall provide communication with all analog/addressable devices (initiating/control) connected to the system through two (2) analog/addressable communications loops. Each loop shall communicate with a maximum of ninety-nine analog detectors and ninety-eight addressable monitor/control devices.
- B. The first nine-nine addressed (1-99) on each loop shall be dedicated to analog detectors, while addresses 101-198 shall be reserved for addressable monitor/control devices.

2.07 Analog/Addressable Communications Loops:

- A. All initiating devices shall be connected to their addressable loop via a two wire style 4 (class B) circuit.

2.08 Notification Appliance circuits:

- A. Four (4) independent (class B) notification appliance circuits shall be provided on the SCU, each polarized and rated at 1.75 Amps DC, individually fused and supervised for opens, grounds, and short circuits. They shall be capable of being wired Class "A" (style Z) or class "B" (style Y) supervised and fused @ 2 Amps. Specifications are as follows:

Voltage	Current
24VDC Non-Regulated	1.75 Amps: Maximum Alarm
	.001 Amps: Normal Standby

2.09 Trouble Input:

- A. Trouble input shall be provided rated at 5-24 Volts input and, if used, shall accept a trouble from an external source.

2.10 Trouble Dry Contacts:

- A. Trouble dry contacts (form A or Form B; jumper selectable) shall be provided rated at 2 Amps at 24 VDC (resistive) and shall transfer whenever a system trouble occurs.

2.11 Alarm Dry Contacts:

- A. Alarm dry contacts (form C) shall be provided rated at 2 Amps at 24 VDC (resistive) and shall transfer whenever a system alarm occurs.

2.12 Central Station Monitoring:

- A. The entire fire alarm system shall be connected via leased telephone lines and radio communications to a central station and in accordance with the requirements of the fire department.

2.13 Alarm Signals:

- A. All alarm signals shall be automatically "locked in" at the control panel until the operated device is returned to its normal condition and the control panel is manually reset. When used for Water flow, the silence switch shall be bypassed.
- B. Alarm or Trouble Activation of Initiating Zones.
- C. Alarm or Trouble activation of initiating zones shall be indicated by zone alarm and trouble LED's.

2.14 Detection Devices:

A. Manual Pull Stations:

- 1. Provide non coded, addressable, semi-recessed, double-action type manual pull station with mechanical reset features. Where installed in existing buildings, boxes may be surface-mounted. Surface mounted boxes shall be the same color as the pull stations.
- 2. Provide separate screw terminal for each conductor connected to the manual alarm pull station. Break-glass-front pull stations will not be permitted. Provide red aluminum, housing labeled "fire". The pull stations shall not be resettable without the use of a key. [Provide Stopper II Guards for all manual stations in public areas].

B. Detectors:

- 1. Each photoelectric smoke detector and heat detector shall be interchangeable via twist-lock mounting base, to ensure matching the proper sensor to the potential hazards of the areas being protected. The system shall recognize when an improper sensor type has been installed in a previously programmed sensor type location.

C. Photoelectric Smoke Detector:

- 1. Provide white flame retardant plastic, addressable, analog, photoelectric type, smoke detectors. Detectors shall operate using an optical sensing chamber principal which complies with UL 268.
- 2. Each detector shall be capable of being set at two sensitivity settings.

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3. Each detector shall have two LED visual indicators providing local 360 degree visibility of operating status and alarm indication.
4. Each detector shall be supported independently of wiring connections, and connected by separate screw terminals of each conductor.
5. The detector screen and cover assembly must be easily removable for field cleaning.

D. Combination Fixed Temperature, rate of Rise Heat Detectors:

1. Provide off-white flame retardant plastic, addressable, combination 140 degree F fixed temperature, rate of rise heat dual thermistor detectors. Detector shall initiate an alarm when temperature rises at a rate of over 15 degrees F per minute or above 140 degrees F.
2. Each detector shall have two LED visual indicators providing local 360 degree visibility of operating status and alarm indication.
3. Contacts shall be self-resetting after response to rate or rise principal. Locate detectors in accordance with UL FPD or FM P7825 listing and the requirements of NFPA 72. Temperature rating of detectors shall be in accordance with NFPA 72.

E. Addressable Monitor Module: provide addressable monitor module wired as style B (class "B") to provide an address for normally open contact devices.

1. Provide Addressable Monitor Module to monitor status of all Water flow Switches, Valve tamper Switches and Post Indicator Valves.

2.15 Alarm Notification Devices:

- A. Color of notification appliances shall be red [white], unless otherwise noted by District.
- B. All alarm notification devices shall be synchronized throughout the school campus building.
- C. Strobe Lights: Provide recessed mounted strobe light assembly suitable for use in electrically supervised circuit. Lamps shall be xenon flashtube type, powered from the fire alarm control panel alarm signaling circuit. Strobes shall provide candela ratings as indicated on the drawings and flash 60 times per minute unless otherwise noted. Strobes in toilets shall provide a minimum of 15 candelas. Lamps shall be protected by a clear polycarbonate lens. Housing shall be labeled "FIRE" in red vertical lettering.
- D. Horns/Strobes: Provide recessed mounted, grille face, vibrating diaphragm type, audio alarm devices consisting of an electro-mechanical horn suitable for use in an electrically supervised circuit. Horn/Strobes shall be provided with a red, tamper resistant grill. Horn shall have a minimum sound rating of 90 DBA at 10 feet and have field selectable sound levels. Horns shall be capable of providing a synchronized, field selectable, temporal code 3 tone. Horns shall have a separate minimum candela as shown on the drawings and flash 60 times per minute unless otherwise noted. Lamps shall be protected by a clear polycarbonate lens. Housing shall be labeled "FIRE" in red vertical lettering.

- E. Horns: Provide recessed mounted, grille face, vibrating diaphragm type, audio alarm devices consisting of an electro-mechanical horn suitable for use in an electrically supervised circuit. Horns shall be provided with a red, tamper resistant grill. Horn shall have a minimum sound rating of 90 DBA at 10 feet and have field selectable sound levels. Horns shall be capable of providing a synchronized, field selectable, temporal code 3 tone. Horns shall have a separate screw terminal for each conductor connection.

- F. Exterior Horns: Provide recessed mounted, grille face, vibrating diaphragm type, audio alarm devices consisting of an electro-mechanical horn suitable for use in an electrically supervised circuit. Horns shall be provided with a red, tamper resistant grill, and a weatherproof backbox. Horn shall have a minimum sound rating of 90 DBA at 10 feet and have field selectable sound levels. Horns shall be capable of providing a synchronized, field selectable, temporal code 3 tone. Horns shall have a separate screw terminal for each conductor connection. Horns located in areas subject to moisture or exterior atmospheric conditions, shall be approved for such locations.

- G. Field Charging Power Supply (FCPS):
 - 1. The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.
 - 2. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to support 60 hour standby.
 - 3. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
 - 4. The FCPS shall include an attractive surface mount backbox.
 - 5. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.
 - 6. The FCPS include power limited circuitry, per 1995 UL standards.

2.16 Wiring and Conduit:

- A. Provide wiring in accordance with NFPA 72.

- B. Conductors shall be solid copper. Conductors for 120 volt circuits shall be No. 12 AWG minimum; conductors for low-voltage DC circuits shall be No. 14 AWG minimum for annunciation circuits and No. 14 AWG minimum for initiation circuits. All cables shall be rated and code compliant for their use.
 - 1. All low voltage wiring not installed in conduits shall be plenum rated.
 - 2. Provide color-coded conductors. Identify conductors by plastic-coated, self-sticking, printed markers or by heat-shrink type sleeves. Each conductor used for the same specific function

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shall be distinctly color coded. Use different color codes for each interior circuit. Each circuit color code wire shall remain uniform throughout the circuit.

3. Pigtail or "T" tap connections to the evacuation alarm horns, horn/strobes and strobes are not acceptable.
4. Underground circuit or circuits in wet areas shall be gel filled cables in scheduled 40 PVC conduit. There shall be no splicing of any underground cables.

C. Conduits:

1. Identification of Conduit: New conduits containing fire alarm system conductors shall be [red], $\frac{3}{4}$ " minimum. Junction-boxes, covers, gutters, and terminal cabinets, containing fire alarm system conductors, shall be painted red or provided red in color with engraved plastic identification signs permanently attached to the equipment.
2. Do not run fire alarm circuits in the same conduit with the non-fire alarm circuits.
3. Do not run AC circuits in the same conduit with the fire alarm circuits.
4. Provide wiring in rigid metal conduit for exterior installations or where exposed to damage.
5. Conceal conduit in finished areas of new construction and wherever practical in existing construction. Conduit runs shall be straight, neatly arranged properly supported and parallel or perpendicular to walls and partitions. Identify conductors within each enclosure where a tap, splice, or termination is made.

PART 3 - EXECUTION

3.01 Installation:

- A. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with the NFPA publications and as modified herein.
- B. Follow manufacturer's directions in all cases for installation, testing and energizing.
- C. Accurately set, level, support, and fasten all equipment.
- D. Smoke and heat detectors:
 1. No detector shall be located closer than 12 inches to any part of any lighting fixture. Detectors, located in areas subject to moisture or exterior atmospheric conditions, or hazardous locations as defined by NFPA 70, shall be approved for such locations.
 2. Provide guards for all detectors mounted in any high athletic activity areas such as gym's, wrestling rooms, shower rooms.
- E. Conduit where exposed shall be installed parallel with the walls or structural elements; vertical runs to be plumb; horizontal runs to be level or parallel with structure; conduit grouped neatly together with straight runs, all bends parallel and uniformly spaced.

- F. Earthquake Resistant installation/fastening of all electrical equipment shall conform to the general requirements of section 1614A of the California Building Code.

3.02 Preliminary Tests:

- A. Conduct the following tests during installation of wiring and system components. Correct deficiency pertaining to these requirements prior to formal functional and operational tests of the system, preliminary tests shall be performed in the presence of the Local Fire Authority and Project inspector of Record to determine the conformance with the specified requirements.
- B. Ground Resistance: Measure the resistance of each connection to ground. Ground resistance shall not exceed 10 ohms.
- C. Dielectric Strength insulation Resistance: Test the dielectric strength and the Insulating resistance of the system interconnecting wiring by means of an instrument capable of generating 500 volts of DC and equipped to indicate leakage current 1000 megohms. For the purpose of this test, connect the instrument between each conductor on the line and between each conductor and ground at the control panel end of the line, with the other extremity open circuited and all series-connected devices in place. The system shall withstand the test without breakdown and shall indicate a resistance of not less than 1.0 minute with a DC potential of not less than 100 volts and not more than 500 volts.
- D. Standby Battery Test: prior to formal inspection and tests, place the fire alarm system on standby battery power for 24 hours; immediately thereafter, sound the building evacuation alarm signaling devices for 5 minutes. When the test is complete, the fire alarm system battery charger shall be fully recharged within 24 hours.
- E. Field Inspection and Test:
 - 1. Before final acceptance of the work, pre-test system to demonstrate compliance with the contract requirements. System shall be subjected to complete functional and operational tests, including tests in place of each detector. When tests have been completed and corrections made, submit a signed and dated NFPA Certificate of Completion along with a completed testing matrix with the request for formal inspection and tests.
 - 2. Where application of heat would destroy a heat detector, it may be manually activated.
 - 3. Verify the proper receipt of the alarm signals at the central station for the UDACT provide printout of test reports. It shall be the sole obligation of the contractor to coordinate and to provide all testing documentation from the central station.
 - 4. The communication loops and the indicating appliance circuits shall be opened in at least two locations per zone to check for the presence of correct supervisory circuitry.
 - 5. Perform the field inspection and test in the presence of the manufacturer's representative, the School District's representative, local Fire Authority and Project Inspector of Record (IOR).

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6. Test equipment: It shall be the responsibility of the installing Contractor to furnish tools, instruments, and materials required for a thorough test of the system. This includes, but is not limited to, the following:
 - a. VOM meter
 - b. Manufacturer's recommended smoke detector testing device and sensitivity test equipment.
 - c. Heat source for testing heat detectors.
 - d. Keys to all control panels.
 - e. Ladders

3.03 Project Closeout:

A. As Built Drawings:

1. Provide a complete set (full size scalable) of reproducible "as-built" and AutoCAD format drawings showing installed wiring, color coding, and wire tag notations for exact locations of all installed equipment, specific interconnections between all equipment, and internal wiring of the equipment upon completion of system.

B. Operating and Instruction Manuals:

1. Operating and Instruction manuals shall be submitted prior to testing of the system. Four complete sets of operation and instructions manuals shall be delivered to the School District upon request.
2. Complete, accurate, step-by-step testing instructions giving recommended and required testing frequency of all equipment, methods for testing each individual piece of equipment, and troubleshooting manual explaining how to test the preliminary internal parts or each piece of equipment shall be delivered upon completion of the system.

C. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:

1. Instructions on replacing any components of the system, including internal parts.
2. Instructions on periodic cleaning and adjustment of equipment with a schedule of these functions.
3. A complete list of all equipment and components with information as to the address and telephone number of both the manufacturer and local supplier of each item.
4. User operating instructions shall be provided prominently displayed on a separate sheet located next to the control unit in accordance with U.L. Standard 864.

EMERGENCY VOICE EVACUATION SYSTEM

PART 1.0 - GENERAL

1.1. DESCRIPTION:

A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled Voice Evacuation/Mass Notification control panel.

B. The Voice Evacuation/Mass Notification panel shall comply with NFPA 72 requirements.

1. The Secondary Power Source of the Voice Evacuation/Mass Notification panel will be capable of providing at least 24 hours of backup power with the ability to sustain 15 minutes in alarm at the end of the backup period.

C. The Voice Evacuation/Mass Notification panel shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC, Q9001-1994.

D. The Voice Evacuation/Mass Notification panel and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).

Underwriters Laboratories Inc. (UL) - USA:

UL 864 Standard for Control Units for Fire Protective Signaling Systems

UL 1711 Amplifiers for Fire Protective Signaling Systems

UL 2572 Communication and Control Units for Mass Notification Systems

Other:

NEC Article 250 Grounding

NEC Article 300 Wiring Methods

NEC Article 760 Fire Protective Signaling Systems

Compliant with Unified Facilities Criteria UFC 4-021-01

1. The Voice Evacuation/Mass Notification panel shall be ANSI 864, 9th Edition Listed. Systems listed to ANSI 864, 8th edition (or previous revisions) shall not be accepted.

F. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.

1.2. SCOPE:

A. A microprocessor-controlled Voice Evacuation/Mass Notification control panel shall be installed in accordance with the project specifications and drawings.

1.3. SUBMITTALS

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A. General:

1. Two copies of all submittals shall be submitted to the Architect/Engineer for review.
2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
3. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show system layout, configurations, and terminations.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

D. Software Modifications

1. Provide the services of a qualified technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, programming tools and documentation necessary to modify the Voice Evacuation/Mass Notification Control Panel on site. Modification includes addition and deletion of messages, circuits, zones and changes to system operation. The system structure and software shall place no limit on the type or extent of software modifications on-site.

1.4. GUARANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.5. MAINTENANCE:

- A. Maintenance and testing shall be on a semi-annual schedule or as required by the local AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The Voice Evacuation/Mass Notification Control Panel shall be tested in accordance with the requirements of NFPA 72.
- B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

1.6. POST CONTRACT EXPANSIONS:

- A. The contractor shall have the ability to provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.
- B. As part of the submittal, include a quotation for all parts and material, and all installation and test labor as needed to increase the number of speakers zones or wattage by ten percent (10%).
- C. The quotation shall include installation, test labor, and labor to reprogram the system for this 10% expansion. If additional Voice Evacuation/Mass Notification Control Panel hardware is required, include the material and labor necessary to install this hardware.
- D. Do not include cost of conduit or wire or the cost to install conduit or wire except for labor to make final connections at the Voice Evacuation/Mass Notification Control Panel.
- E. Submittals that do not include this estimate of post contract expansion cost will not be accepted.

1.7. APPLICABLE STANDARDS AND SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

A. National Fire Protection Association (NFPA) - USA:

No. 70 National Electric Code (NEC)

No. 72 National Fire Alarm Code

No. 101 Life Safety Code

B. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.8. APPROVALS:

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A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL Underwriters Laboratories Inc (Ninth Edition)

CSFM California State Fire Marshal

MEA Material Equipment Acceptance (NYFD COA)

PART 2.0 PRODUCTS

2.1. EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a fire protective signaling system, meeting the National Fire Alarm Code.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., speakers shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

D. All equipment must be available "over the counter" through the Security Equipment Distributor (SED) market and can be installed by dealerships independent of the manufacturer.

2.2. CONDUIT AND WIRE:

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760.

4. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. Conduit shall not enter the Voice Evacuation/Mass Notification Control Panel, or any other remotely mounted panel equipment or backboxes, except where conduit entry is specified by the Voice Evacuation/Mass Notification Control Panel manufacturer.

6. Conduit shall be 3/4 inch (19.1 mm) minimum.

B. Wire:

1. All Voice Evacuation/Mass Notification Control Panel wiring shall be new.

2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the Voice Evacuation/Mass Notification Control Panel. Number and size of conductors shall be as recommended by the Voice Evacuation/Mass Notification Control Panel, but not less 14 AWG (1.63 mm) for Notification Appliance Circuits.

3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NEC 760 (e.g., FPLR).

5. All field wiring shall be electrically supervised for open circuit and ground fault.

C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

D. The Voice Evacuation/Mass Notification Control Panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as Voice Evacuation/Mass Notification Control Panel. Voice Evacuation/Mass Notification Control Panel primary power wiring shall be 12 AWG. The panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

1. The Voice Evacuation/Mass Notification Control Panel notification circuit (NACs 1) shall also automatically synchronize any of the following manufacturer's notification appliances connected to them: System Sensor, Wheelock, or Gentex with no need for additional synchronization modules.

2.3. Voice Evacuation/Mass Notification Control Panel:

A. The Voice Evacuation/Mass Notification Control Panel shall be: Notifier NFS2-3030 (with Digital Voice Command Center) and contains a microprocessor-based Central Processing Unit (CPU). The CPU shall distribute and control emergency voice messages over the speaker circuits.

B. The system shall provide the capability to interface to **LOC (Local Operator Console)**, Distributed Audio Amplifiers, Remote Page Unit, Remote Microphone, Fire Fighter Telephone Unit and Remote Telephone Zone Module from the same manufacturer.

C. Shall have as minimum requirements:

1. Integral 50 Watt, 25 Vrms audio amplifier with optional converter for 70.7 volt systems. The system shall be capable of expansion to 100 watts total via the insertion of an additional 50-watt audio amplifier module (can be used as a backup amplifier) into the same cabinet and expandable over 1100 watts.

2. Speaker circuit that can be wired both Class A and B.

3. Integral Digital Message Generator with a memory capacity for up to 60 seconds per messaging. The Digital Message Generator shall be capable of producing fourteen distinct messages (60 seconds each). Field-selectable message and custom message recording capability using the local microphone, a USB port, or an external audio input.

4. Built in alert tone patterns with ANSI, March Code, California,

Steady, Alert Tone, Hi-Lo, ANSI Whoop, Continuous Whoop, or No Tone is field programmable. Tone Prior to transmitting a message, the Voice Evacuation/Mass Notification Control Panel can be programmed to produce a pre-announce

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and post-announce tone.

- a. **Leading Tone Duration** If a pre-announce tone is desired, select the length of time it will play before a message is broadcasted. Select 4, 8, 12, 16, 20, 24, or 28 seconds. In a pre-announce tone is not desired, select 0 seconds.
 - b. **Trailing Tone Duration** Select the length of time for the post-message announcement tone. Select 4, 8, 12, 16, 20, 24, 28, or 32 seconds from the drop-down menu.
 - c. **Repeat Cycle** Select the number of times the message will be repeated during an alarm. A message can be repeated 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, or an *Infinite* amount of times.
5. The Voice Evacuation/Mass Notification Control Panel will be capable of detecting and annunciating the following conditions: Loss of Power (AC and DC), System Trouble, Ground Fault, Alarm, Microphone Trouble, Message Generator Trouble, Tone Generator Trouble, and Amplifier Fault.
6. The Voice Evacuation/Mass Notification Control Panel shall be fully supervised including microphone, amplifier output, message generator, speaker wiring, and tone generation.
7. Speaker outputs shall be fully power-limited.
8. Amplifiers will be supplied power independently to eliminate a short on one circuit from affecting other circuits.
9. The Voice Evacuation/Mass Notification Control Panel will provide full supervision on both active (alarm or music) and standby conditions.
10. An optional zone splitter version shall be available that permits splitting speaker circuits into 8 specific zones.
11. An optional distributed amplifiers unit shall be available that permits splitting speaker circuits up to a total of 24 speaker zones.
12. Wiring terminals shall be removable terminal blocks (Wire Gauge 12 – 18 AWG) for ease of servicing.
13. Voice Evacuation/Mass Notification Control Panel will provide 2 amp Notification Appliance Circuit (NAC) output with sync generator or follower for System Sensor, Wheelock or Gentex protocols. The NAC shall be capable of One (1) Style Y (Class B) or Style Z (Class A) circuit.
14. Shall have eight Command Input Circuits to activate messages via reverse polarity or contact closures.
15. Built in External Audio Input can be used for background music.
16. On-board battery charger which supports charging up to 26 AH batteries (cabinet holds up to 18AH batteries).
17. Programmable delay of immediate, 2 hours or 6 hours reporting of AC Loss.
18. Built in Piezo sounder for local trouble.
19. Stores the events in the 100 Event History log

20. Shall have Console Lamp Test switch and shall activate all system LEDs including Remote Consoles.
21. Shall have three Form-C relays:
 - AC Power Loss Relay
 - System Trouble Relay
 - MNS Active (For Mass Notification signage)
22. Shall have a Special Application (auxiliary power) output for addressable modules when interfaced with compatible addressable FACP's and End-of-Line power supervision relays.
23. Shall be capable of Speaker Volume Control. The Supervised Volume Control will allow manual volume setting for telephone paging and background music for a specific speaker or speaker zone.
24. Shall have a Night Ring input allows a building's Private Branch Exchange (PBX) to activate the Voice Evacuation/Mass Notification panel.
25. The Voice Evacuation/Mass Notification panel can communicate in any combination up to eight (8) external remote consoles:
 - Optional Remote Microphone
 - Optional Remote Page Unit
 - Optional Local Operator Console
26. The Voice Evacuation/Mass Notification panel can communicate in any combination up to eight (8) external distributed audio amplifiers:
 - Optional Distributed Amplifier, 50 watts.
 - Optional Distributed Amplifier, 125 watts.
27. Shall be capable of integrating with firefighter telephone system that provides secure and reliable communications. The firefighter telephone system will allow for up to ten users to plug in to a remote telephone jack and communicate simultaneously within a building.
28. Shall be capable of secure access to the Voice Evacuation/Mass Notification panel via cell phone or other remote telephone.
29. The Voice Evacuation/Mass Notification panel can be integrated by an FACP via the ANN/ACS (EIA-485) link. Compatible FACP's include the MS-9200UDLS and MS-9600(UD)LS.
30. The Voice Evacuation/Mass Notification shall report Mass Notification events to the Central Station.
31. The Voice Evacuation/Mass Notification panel can be interface with other UL Listed Fire Alarm Control Panels via activation of reverse polarity or by contact closure.

D. Speakers:

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1. All speakers shall operate on 25 or 70 VRMS with field selectable output taps from 0.25 to 2.0 Watts.
2. Speakers in corridors and public spaces shall produce a minimum sound levels of 75 dBA output at 10 feet (3m).
3. The plug-in speaker allows the installer to pre-wire mounting plates and dress the wires before plugging in the speakers.
4. Flush mount applications are achievable without the need for an extension ring.
5. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
6. Rotary switch simplifies field selection of speaker voltage and power settings.

E. Enclosures:

1. The Voice Evacuation/Mass Notification panel shall be housed in a UL-listed cabinet suitable for surface mounting. The cabinet and front shall be corrosion protected and painted red via the powder coat method with manufacturer's standard finish.
2. The back box and door shall be constructed of steel with provisions for electrical conduit connections into the sides and top.
The door shall provide a key lock and shall provide for the viewing of all indicators.

F. Power Supply:

1. The main power supply for the Voice Evacuation/Mass Notification panel shall provide up to 7.5 amps of available power for the panel and peripheral devices.
2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. The power supply shall provide an integral battery charger or may be used with an external battery and charger systems. Battery arrangement may be configured in the field.
4. The main power supply shall continuously monitor all field wires for earth ground conditions.
5. The main power supply shall operate on 120 VAC, 60 Hz or 240 VAC, 50 Hz, and shall provide all necessary power for the Voice Evacuation/Mass Notification panel.

G. BATTERIES:

1. Upon loss of Primary (AC) power to the Voice Evacuation/Mass Notification panel, the batteries shall have sufficient capacity to power the Voice Evacuation/Mass Notification panel for required standby time (24 or 60 hours) followed by 15 minutes of alarm.
2. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

PART 3.0 - EXECUTION

3.1. INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming

and test period. If construction is ongoing during this period, measures shall be taken to protect speakers from contamination and physical damage.

3.2. TEST:

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

B. Open and short notification appliance circuits and verify that trouble signal actuates.

C. Ground all circuits and verify response of trouble signals.

D. Check presence and audibility of tone at all alarm notification devices.

E. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying voice messages.

3.3. FINAL INSPECTION:

A. At the final inspection a minimum NICET Level II technician shall demonstrate that the system functions properly in every respect.

3.4. INSTRUCTION:

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor or installing dealer shall provide a user manual indicating "Sequence of Operation."

END OF SECTION

SECTION 28 55 00

RF SURVEY FOR EMERGENCY RESPONDER RADIO ANTENNA/REPEATER BDA SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. The purpose of this specification is to establish the requirements and standards for initial survey for public safety radio signal strength per NFPA and IFC
- B. Survey should be performed after the building is substantially completed, and prior to start of installation of electrical wiring.
- C. Conduct a survey using a RF Spectrum Analyzer, a calibrated, system-compatible radio or another suitable instrument with traceable certificate of calibration to analyze the RF signal strength of Emergency Responder Radio Signal into the building and determine if amplification of the signal is required. Both inbound and outbound signal strength shall be determined, measured, calculated and documented as required by code.

1.02 SURVEY CRITERIA IF REQUIRED

- A. The required Public Safety Radio Signal Level inside the Owner's facility must be determined per code, ordinance or AHJ
- B. Survey shall be performed by an FCC licensed technician holding a current GROL license. NOTIFIER have distributors that meet these requirements.

1.03 REGULATIONS

- A. Codes, regulations and standards referenced in the Section are:
 - 1. NFPA 1 – The National Fire Code (including Annex O from 2009)
 - 2. NFPA 70 – The National Electrical Code
 - 3. IFC 510- Emergency Responder Radio Coverage
 - 4. NFPA 101, Life Safety Code, the Ohio Building Code, and Local Code and Building Authority requirements.
 - 5. NFPA 72 National Fire Alarm Code
 - 6. FCC 47 CFR Private Land Mobile Radio
 - 7. 90.219 Services-Use of Signal Boosters
 - 8. ICC International Fire Code, Code and Commentary
 - 9. Local or State Promulgated Fire Code
 - 10. ADA "Americans with Disabilities Act"
 - 11. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"
 - 12. FCC Rules Part 22, Part 90 and Part 101
 - 13. NFPA 1221 2016 Edition
 - 14. International Building Code 2012 / 2015 / 2018
 - 15. UL 2524

1.04 DEFINITIONS

- A. Definitions:

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1. Bi-Directional Amplifier BDA: Device used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage.
2. Emergency Responder Radio Coverage System: A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services, or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.
3. FCC: Federal Communications Commission
4. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
5. Public Safety/First Responder: Public Safety or First Responder agencies that are charged with the responsibility of responding to emergency situations. These include, but are not limited to law enforcement departments, fire departments, and emergency medical companies.
6. RSSI: Received signal strength indicator RSSI is a measurement of the power present in a received radio signal.
7. BER: Bit Error Rate is the number of bit errors per unit time
8. GROL- FCC General Radio Operators License
9. ERRCES- Emergency Responder Radio Coverage Enhancement System
10. DAS-Distributed Antenna System

1.05 EXECUTION

A. Testing Procedures

1. Minimum Signal Strength: For testing system signal strength and quality, the testing shall be based on the -95dBm nominal signal at 100%.
2. Spectrum Analyzer or Calibrated Handheld Radio shall be used as basis for signal measurements or other method as approved by AHJ.
3. Testing should be based on a minimum of 20 grid locations per floor OR maximum of 1600 SQ ft. areas if the floor exceeds 32,000 Sq. Ft. Also, testing should include all critical areas per NFPA. See 1.02 of this specification and NFPA 72 2013 or NFPA 1221 2016. OR per any method determined by the AHJ, local code or ordinance.
3. A minimum signal strength of -95 dBm shall be provided throughout the coverage area for both uplink and downlink by the Local Fire Department.
 - a. RSSI measurement only

1.06 SURVEY SUBMITTALS

A. Submit testing data for each level of the building.

1. An RF measurement drawing of each floor of the building which indicates relative RF field strength for each frequency band of interest must be submitted to the AHJ.
2. The drawing should indicate clearly the areas that have passed or failed based on the above parameters.

END OF SECTION

SECTION 28 50 00.01

**NOTIFIER EMERGENCY RADIO COMMUNICATION ENHANCEMENT SYSTEM
(BDA SYSTEM)**

1.1 EMERGENCY RADIO COMMUNICATION ENHANCEMENT SYSTEM (BDA SYSTEM)

A. General

1. Provide an in-building radio signal amplification system to provide complete coverage in the building for the public safety agencies as required by the local AHJ (Authority Having Jurisdiction). System users shall receive and transmit radio signals from their portable radio units within the building. This shall be accomplished utilizing the following components:
 - a. Bi Directional Amplifiers (Signal Boosters)
 - b. Coaxial Cable
 - c. Antennas
 - d. Cable taps
 - e. Connectors
 - f. Power dividers
 - g. Other components and interconnecting circuitry as required
2. The system shall comply with the requirements of UL2524 In-building 2-Way Emergency Radio Communication Enhancement Systems, NFPA 72 2013 Edition, NFPA 1221 2016 Edition and IFC 2015, as referenced.
3. The entire system shall meet the requirements of the Fire Department, the Building Department and all other agencies and authorities having jurisdiction (AHJ).
4. The work in this section shall include the responsibility for all permit requirements with the AHJ. Where filings require engineer's signature, documents shall be submitted for his review and signature. This responsibility shall include furnishing of required quantities of floor plans, descriptive notes and/or specifications, wiring diagrams, shop drawings and amendment forms.
5. Early completion of the in-building emergency radio communication enhancement system will be required as to permit a Certificate of Occupancy to be obtained in a timely manner
6. Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included
7. The in-building emergency radio communication enhancement system shall use a UL2524, NFPA 72, NFPA 1221 and IFC 2018 compliant NOTIFIER signal booster or approved equal.

B. Design requirements

1. In-building emergency radio communication enhancement systems for emergency responders are an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable emergency responder communications at the required signal strength within the specified areas.
2. Critical Areas such as emergency command center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas shall be provided with 100% floor area radio coverage.

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3. General building areas shall be provided with 95% radio coverage, or as specified by AHJ.
4. The In-building emergency radio communication enhancement systems must provide the following signal strengths:
 - a. Downlink - Minimum signal strength of -95 dBm throughout the coverage area.
 - b. Uplink - Minimum signal strength of -95 dBm received at the AHJ Radio System.
 - c. OR As otherwise required by the AHJ
5. The system shall be complete with all components and wiring required for compliance with all applicable codes and regulations, and for its operations described hereinafter.
6. An approved manufacturer or a qualified and approved vendor shall supply, test and determine locations of components which are required for proper operation as well as to supply, install, test and certify the performance of the complete system. Vendor qualifications must be acceptable to the AHJ.
7. Design shall include iBwave software-simulated radio propagation modeling with heat maps showing predicted signal coverage levels within the building. The iBWave design shall be done by iBWave certified personnel.
8. All tests shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License. All testing personnel shall be certified and authorized by the signal booster manufacturer in the installation and operation of their equipment. Personnel qualifications must be acceptable to the AHJ.
9. The system design shall be based on the NOTIFIER line of Public Safety Signal Boosters UL2524, NFPA 72, NFPA 1221, IFC and FCC certified to establish standards of quality for materials and performance. The naming of a specific manufacturer or a catalog number does not waiver any requirement or performance of individual components described in the specifications.
10. Assembly and installation of all components of the Emergency Responder Radio Communication Enhancement System shall comply with all applicable sections of the National Electrical Code.
11. Survivability from attack by fire shall meet requirements of NFPA 72, NFPA 1221, IFC or as required by the local jurisdiction.
12. The system must comply with all applicable sections of the FCC rules. Signal booster shall have FCC certification prior to installation.
13. Antenna isolation shall be maintained between the donor antenna and all inside antennas (D.A.S.) to a minimum of 20dB under all operating conditions

C. Technical Specifications and Performance Requirements

1. The system specified shall be based upon NOTIFIER line of Public Safety UL2524, NFPA72, NFPA 1221, IFC compliant signal boosters
2. The signal booster shall be a Class B Public Safety type as designated by the FCC or as required by the AHJ.

3. The secondary power supplies, battery chargers and system monitoring shall be fully compliant with NFPA 72, NFPA 1221 and IFC. The signal booster shall have both the primary and the secondary power supplies within a waterproof, type-4 approved enclosure.
4. All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC ID must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.
5. The signal booster shall be pre-set by the equipment manufacturer for the frequencies specified by the AHJ. Field tuning of RF filters and duplexers is not allowed.
6. UHF and VHF signal boosters shall be band selective type with a maximum 3dB channel bandwidth of 200KHz (Fc +/- 100KHz) per band. Non-selective wide-band signal boosters shall not be accepted, unless required to cover multiple channels within the same band.
7. Signal Boosters shall have oscillation suppression circuitry to protect the public safety radio system in case of system malfunction or other causes. The oscillation suppression circuit shall not disable the system operation. Systems that automatically disable the signal booster upon oscillation detection shall not be allowed.
8. Signal Boosters shall have uplink noise suppression function to eliminate uplink noise while in standby (i.e. no radio transmission from within a building). Systems that produce any measurable level of uplink noise while in standby shall not be allowed.
9. Signal Booster gain shall be rated at minimum of 80dB and the gain shall be adjustable in a minimum of 30dB range. System gain shall be set and documented at the time of the final system test.
10. Maximum Propagation delay of the signal booster system shall be 14 μ s (microseconds) or as specified by AHJ.
11. The signal booster system shall include built-in automatic supervision of malfunctions of the signal booster and battery system as per NFPA 1221 NFPA 72 and IFC. Non-OEM equipment add-ons and modifications to comply with this specification shall not be allowed.
12. A dedicated supervised monitoring panel shall be provided within the emergency command center next to the fire alarm panel / annunciator or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
 - a. Normal AC power
 - b. Signal booster trouble
 - c. Antenna Failure
 - d. Loss of normal AC power
 - e. Failure of battery charger
 - f. Low battery capacity
13. If signal booster is supervised by a NOTIFIER fire alarm panel, the signal booster system shall include a compatible, OEM built-in NOTIFIER addressable monitoring module. If signal booster is supervised by other brand FACP, the signal booster shall be Honeywell branded model with universal normally open relays for connection to external monitoring modules.

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14. External filters, duplexers, power supplies or other non-OEM additions or modifications of the original equipment shall not be allowed. All duplexers shall be built-in and FCC certified with the signal booster as a complete and fully integrated FCC-certified and UL-Listed unit.
15. All signal booster components shall be contained in a type-4 approved waterproof enclosure. All enclosures shall be painted red with external labeling as required by the AHJ.

D. Installation Requirements

1. Installation of all components of the Emergency Responder Communication Enhancement System shall comply with all applicable sections of the National Electrical Code NFPA-70, NFPA-72, NFPA 1221, IFC or as required by the local AHJ.
2. At least 2 independent and reliable power supplies shall be provided as specified in NFPA 72, NFPA 1221 and IFC.
3. The primary power source shall be supplied from a dedicated twenty (20) ampere branch circuit and comply with NFPA-70 National Electrical Code, NFPA 72 and NFPA 1221 2016 edition.

The signal booster shall be equipped with a secondary source of power. The secondary source of power shall be a battery system with a dedicated battery charger powered by a separate, dedicated twenty (20) ampere branch circuit. The secondary power supply shall power on automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage enhancement system for a period of at least 24 hours. The battery system shall automatically charge in the presence of external power input. Battery charger and all other electronic components must be fully enclosed in a waterproof Type-4 approved enclosure. Batteries shall be enclosed in a separate, vented Type-3R approved enclosure. External UPS (Uninterruptable Power Supplies) are not acceptable.

4. RF Coaxial Cable shall be a listed, CMP plenum. Non-plenum cable can be used when installed in a metallic raceway. The cable classification shall be clearly marked on the outer surface of the cable regular intervals.

E. Acceptance and Test Procedures

1. Acceptance testing for an in-building radio system is required upon completion of installation.
2. The coverage testing shall be done in accordance with NFPA 72, NFPA 1221, IFC and as required by the local AHJ
3. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License.
4. All test records along with system diagrams, iBWave design, equipment specifications, user manuals, RF link budget calculations, battery backup calculation and other design data shall be submitted upon completion of the project, and as required by the AHJ.

END OF SECTION