

CLASSROOM OFFICE BUILDING 1 RENOVATION
Merced, California

UC Merced Project No.
908078

Owner
University of California Merced

Architect
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MEP/FP Engineers
Gayner Engineers



02.27.2020

99% CONSTRUCTION
DOCUMENTS VOLUME 2 OF 2



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The following listed documents comprise the project manual for the project listed above. Where numerical sequence of sections is interrupted, such interruptions are intentional.

The complete Project Manual for this project consists of the listed Volume, which must not be separated for any reason. The Architect and Owner disclaim any responsibility for any assumptions made by a contractor or subcontractor who does not receive a complete Project Manual, including all sections listed in the Table of Contents.

All Division 01 Sections are a part of and apply to each and every Section of the Project Manual Specifications.

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SECTION 02 4119
SELECTIVE DEMOLITION

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Demolition and removal of selected portions of building or structure.
 2. Salvage of existing items to be reused or recycled.

1.2 REFERENCES

- A. Definitions:
1. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
 2. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
 3. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
 4. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Demolition Meetings:
1. Pre-Demolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination" following Pre-Construction Conference requirements.

1.4 ACTION SUBMITTALS

- A. Demolition Schedule: Submit to University's Representative for approval, before Work begins.
- B. Demolition Plan: Submit to University's Representative for approval, before Work begins.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Pre-Demolition Photographs or Video: Submit before Work begins.

- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.
- D. Utility Interruption Notification: Submit to University's Representative, Exhibit 18 Utility Service Interruption/Shut Down Requests, before Work begins.

1.6 CLOSEOUT SUBMITTALS

- A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.7 QUALITY ASSURANCE

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

1.8 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.
- G. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- H. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure during selective demolition operations.

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

PART 2 – PRODUCTS

2.1 PERFORMANCE

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

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or preconstruction videotapes.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations.
- B. Removed and Salvaged Items:
 - 1. Store items in a secure area until delivery to Owner.
 - 2. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations.

END OF SECTION

SECTION 06 4023

INTERIOR ARCHITECTURAL WOODWORK

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Interior Millwork
 2. Wall Surfaces
 3. Casework
 4. Shelving

1.2 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site and related Work.

1.4 ACTION SUBMITTALS

- A. Product Data: For panel products, fire-retardant treated materials, high-pressure decorative laminate, adhesive for bonding plastic laminate, solid-surfacing, quartz agglomerate material, cabinet hardware and accessories and finishing materials and processes.
1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by the treating plant that treated the materials comply with requirements.
- B. Shop Drawings: Show fabrication and installation of the Work. Include the following.
1. Location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 2. Show details full size.
 3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

4. Show locations and sizes of cutouts and holes for plumbing fixtures faucets soap dispensers and other items installed in architectural woodwork.
5. Apply AWI-certified compliance label to first page of Shop Drawings.
- 6.

C. Samples:

1. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only.
 - a. Lumber: For each species and cut, finished on one side and one edge.
 - 1) Transparent Finish (shop-applied): 50 sq. inch (32,250 sq mm) for each species and cut.
 - a) Step finish materials on sample to show and clearly define each coat.
 - 2) Opaque Finish (shop-applied): 50 sq. inch (32,250 sq mm) for color and finish.
 - b. Wood Veneer:
 - 1) Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
 - c. Plastic Laminate-Clad Panel Products:
 - 1) 8 inch by 10 inch (203.2 mm x 254 mm), for each type, color, pattern, edge conditions and surface finish, with separate samples of unfaced panel product used for core.
 - d. Thermoset Decorative-Overlay Surfaced Panel Products:
 - 1) 8 inch by 10 inch (203.2 mm x 254 mm), for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
 - e. Cabinet Hardware:
 - 1) Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Sustainability Submittals:

1. Refer to Division 01 Section "LEED Requirements" for requirements.
2. Product Certificates: For each type of product, signed by product manufacturer.
3. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification.
4. Qualification Data: For fabricator.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers and wood paneling.

- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Regulatory Requirements: Comply with accessibility requirements, comply with the 2010 ADA Standards for Accessible Design, state accessibility and local accessibility codes.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.
- C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements.
 - 1) Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 – PRODUCTS

2.1 PERFORMANCE

A. Design Requirements:

1. Architectural Woodwork Institute, Woodwork Manufacturers Association of Canada and Woodwork Institute's "Architectural Woodwork Standards, Edition 2, 2014" for grades of architectural woodwork, construction, finishes, and other requirements.
2. The Contract Documents contain selections chosen from options in the Architectural Woodwork Standards as well as additional requirements beyond those of the Architectural Woodwork Standards. Comply with such selections and requirements in addition to the Architectural Woodwork Standards.
3. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
4. Regulatory Requirements: Comply with accessibility requirements, comply with the 2010 ADA Standards for Accessible Design, and ICC/ANSI A117.1 and California Building Code.

B. Performance Requirements:

1. Fire Performance Characteristics: Provide materials identical to those tested for the following fire performance characteristics per ASTM test methods indicated by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify treated lumber with classification marking of inspecting and testing organization in the form of separable paper label or, where required by authorities having jurisdiction, of imprint on lumber surfaces that will be concealed from view after installation.
 - a. Surface Burning Characteristics: Not exceeding values indicated below, tested per ASTM E 84 for 30 minutes with no evidence of significant combustion.
 - 1) Flame Spread: 25.
 - 2) Smoke Developed: 50.

2.2 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Solid Wood:

1. Comply with requirements of the "Architectural Woodwork Standards – Section 3 Lumber" requirements for hardwood and softwood.
 - a. Hardwood for Transparent Finish: Premium, unless otherwise noted. Species and cut as indicated elsewhere.
 - b. Hardwood for Opaque Finish: Custom, unless otherwise noted. Birch, plain sawn.
 - c. Softwood:
 - 1) Concealed Use: Economy. Yellow Poplar, plain sawn.
2. Fire-Retardant-Treated Lumber:
 - a. General: Where indicated, pressure impregnate lumber with fire-retardant chemicals of formulation indicated to produce materials with fire performance characteristics specified.

- 1) Mill lumber after treatment, within limits set for wood removal that does not affect listed fire performance characteristics, using a woodworking plant certified by testing and inspecting organization.
- 2) Kiln-dry woodwork after treatment to levels required for untreated woodwork. Maintain moisture content required by kiln drying before and after treatment.
- 3) Discard treated lumber that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber.

C. Wood Face Veneer:

1. Wood Veneer:

- a. Comply with requirements of the “Architectural Woodwork Standards – Section 4 Sheet Products” requirements for hardwood and softwood veneers.
 - 1) Hardwood for Transparent Finish: Grade AA, unless otherwise noted. Species and cut as indicated elsewhere.

D. Panel Product:

1. Comply with requirements of the “Architectural Woodwork Standards – Section 4 Sheet Products” requirements for hardwood and softwood veneers.
2. Hardboard: AHA A 135.4.
3. Medium-Density Fiberboard (MD): ANSI A 208.2.
 - a. Non-Formaldehyde Fire-Retardant Fiberboard: Board tested for flame spread of 25 or less and for smoke developed of 200 or less per ASTM E 84 by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency.
 - b. Basis-of-Design Product:
 - 1) Subject to compliance with requirements, the design is based on the following manufacturer’s product.
 - a) Siera Pine Lt. “Meditate FR”

E. Plastic Laminate:

1. High-Pressure Decorative Laminate: ANSI / NEMA LD 3.

F. Thermoset Decorative Overlay:

1. Decorative surface of thermally fused polyester or melamine-impregnated web complying with DLPA 1992.

G. Metal Materials:

1. Metal Supports and Reinforcement:
 - a. Division 05 Section “Metal Fabrication” for counter framing and support requirements.

H. Hardware and Accessories:

1. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
2. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
3. Back-Mounted Pulls: BHMA A156.9, B02011.
4. Wire Pulls: As indicated in drawings.

5. Adjustable Shelf Standards and Supports: As indicated in drawings.
 6. Shelf Rests: BHMA A156.9, B04013; metal, metal, two-pin type with shelf hold-down clip.
 7. Drawer Slides: BHMA A156.9, B05091.
 - a. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
 - b. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 inches high and 24 inches wide.
 - c. File Drawer Slides: Grade 1HD-200; for drawers more than 6 inches high or 24 inches wide.
 - d. Pencil Drawer Slides: Grade 1; for drawers not more than 3 inches high and 24 inches wide.
 - e. Keyboard Slides: Grade 1HD-100; for computer keyboard shelves.
 - f. Trash Bin Slides: Grade 1HD-200; for trash bins not more than 20 inches high and 16 inches wide.
 8. Door Locks: BHMA A156.11, E07121.
 9. Drawer Locks: BHMA A156.11, E07041.
 10. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - a. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 - b. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
 - c. Satin Stainless Steel: BHMA 630.
 11. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- I. Miscellaneous:
1. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
 2. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
 3. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
 4. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

2.3 FABRICATION

A. General:

1. Comply with requirements of the "Architectural Woodwork Standards" requirements for each type of woodwork required.
2. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.
3. Fabricate woodwork to dimensions, profiles, and details indicated.
4. Ease edges to radius of 1.5 mm on solid wood and panel products.

5. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - a. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - b. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
 6. Shop-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.
 7. Fire-Retardant-Treated Wood: Sand wood lightly to remove raised grain on exposed surfaces before fabrication.
 8. Install glass to comply with applicable requirements of Division 08 Section "Glass Glazing" and of FGMA "Glazing Manual." For glass in wood frames, secure glass with removable stops.
 9. Provide premium grade construction for items not listed below.
- B. Standing and Running Trim:
1. General:
 - a. Trim items wider than available lumber, use veneered construction. Do not glue for width.
 - b. Rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.
 - c. Back-out or groove backs of flat trim members and kerf backs of other wide flat members, except for members with ends exposed in finished work.
 - d. Assemble casings in plant except where limitations of access to place of installation require field assembly.
 - e. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.
 2. Standard: Comply with "Architectural Woodwork Standards – Section 6 Interior & Exterior Millwork."
 - a. Opaque Finish:
 - 1) Grade: Custom.
 - 2) Wood Veneer Species and Cut:
 - a) Any closed-grain hardwood.
 - b. Field Painted Finish:
 - 1) Grade: Custom.
 - 2) Wood Veneer Species and Cut:
 - a) Any closed-grain hardwood.
- C. Frames and Jambs:
1. Standard: Comply with "Architectural Woodwork Standards – Section 6 Interior & Exterior Millwork."

- a. Non-Rated Door Frames:
 - 1) Transparent Finish:
 - a) Grade: Premium.
 - b) Wood Veneer Species:
 - c) As indicated on the drawings.
 - 2) Opaque Finish:
 - a) Grade: Custom.
 - b) Wood Veneer Species and Cut: Any closed-grain hardwood.
 - 3) Field Painted Finish:
 - a) Grade: Custom.
 - b) Wood Veneer Species and Cut: Any closed-grain hardwood.
 - b. Fire-Rated Door Frames: Provide fire-rated wood frames for wood doors that are identical to units tested in door and frame assemblies per ASTM E 152 and that are labeled and listed for ratings indicated by UL, Warnock Hersey, or other testing and inspection organization acceptable to authorities having jurisdiction. Provide fire labeled and smoke control labeled for fire rated wood frames.
 - 1) Basis-of-Design Product: Subject to compliance with requirements, the design is based on the following.
 - a) The Maiman Company
- D. Wall Surfaces:
- 1. Plastic Laminate Paneling:
 - a. Standard: Comply with "Architectural Woodwork Standards – Section 8 Wall Surfacing."
 - 1) Grade: Premium.
 - 2) Substrate: Medium-density fiberboard. Particleboard and OSB is not allowed on project.
 - 3) Laminate Cladding:
 - b. High Pressure Decorative Laminate:
 - 1) Horizontal Surfaces Other Than Tops: HGS – 0.048-inch (1.2 mm) nominal thickness.
 - 2) Postformed Surfaces: HGP - 0.04 -inch (1 mm) nominal thickness.
 - 3) Vertical Surfaces: HGS – 0.048-inch (1.2 mm) nominal thickness.
 - c. Concealed Surfaces: Surfaced with plastic laminate or thermoset decorative overlay.
 - 1) Match Architect's samples.
- E. Cabinets:
- 1. Plastic Laminate-Clad Cabinets.
 - a. Standard: Comply with "Architectural Woodwork Standards – Section 10 Casework."
 - 1) Cabinet Construction: Type A – Frameless Construction.
 - 2) Door and Drawer Front Style: Flush Overlay.
 - 3) Grade: Premium.
 - b. Substrate: Medium-density fiberboard. Particleboard and OSB is not allowed on project.
 - c. Laminate Cladding:
 - 1) Laminate Grade for Exposed Surfaces:
 - a) Horizontal Surfaces Other Than Tops: HGS – 0.048-inch (1.2 mm) nominal thickness.

- b) Postformed Surfaces: HGP - 0.04 -inch (1 mm) nominal thickness.
 - c) Vertical Surfaces: HGS – 0.048-inch (1.2 mm) nominal thickness.
 - 2) Semiexposed Surfaces:
 - a) GP-50 (0.050-inch nominal thickness).
 - b) Surfaced with plastic laminate or thermoset decorative overlay
 - 3) Colors, Patterns and Finishes:
 - a) As selected by Architect from manufacturer's full line.
 - d. Edge Material: Same as plastic laminate.
 - e. Concealed Surfaces: Surfaced with plastic laminate or thermoset decorative overlay.
 - f. Cabinet Hardware: Refer to Drawings.
 - 1) Cabinet door hinges.
 - 2) Drawer glides.
 - 3) Drawer and door pulls.
 - 4) Drawer and cabinet door locks.
 - 5) Pilaster and clips.
- F. Shelving:
- 1. Utility Shelving.
 - a. Standard: Comply with "Architectural Woodwork Standards – Section 10 Casework."
 - 1) Panel Product:
 - a) Grade: Premium.
 - b) Substrate: Medium-density fiberboard. Particleboard and OSB is not allowed on project.
 - c) Exposed Edge: Solid wood edgeband to match veneer.
 - d) Wood Veneer Species: Quarter sliced. As indicated on the drawings.
 - 2) Hardware: Refer to end of this section for Schedule for the following.
 - a) Shelf Standard and Brackets.
 - b) Shelf Dividers.

2.4 FINISHES

- A. General: The entire finish of interior architectural woodwork is specified in this section, regardless of whether factory applied or applied after installation.
 - 1. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.
 - 2. Backpriming:
 - a. Apply one coat of sealer or primer compatible with finish coats to concealed surfaces of woodwork, including backs of trim, cabinets, paneling, and ornamental work and the underside of countertops.
 - b. Apply 2 coats to back of paneling.
- B. Standard: Comply with "Architectural Woodwork Standards – Section 5 Finishing", unless otherwise indicated.
- C. Factory Finishing: To the greatest extent possible, finish architectural woodwork at factory. Defer only final touch-up, cleaning, and polishing until after installation.

1. Opaque Finish: Comply with requirements indicated below for grade, finish system, staining, effect, and sheen, with sheen measured on 60 deg gloss meter per ASTM D 523.
 - a. Grade: Premium.
 - b. AWS Finish System: System 1. Lacquer, Nitrocellulose.
 - c. Staining: Match Architect's sample.
 - d. Effect: Match Architect's sample.
 - e. Sheen: Match Architect's sample.

D. Field Finishing:

1. Field Painted: Refer to Division 09 Section "Interior Painting" for field paint requirements.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- C. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- D. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- E. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- G. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete

installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

- H. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
 - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
 - 2. Install wall railings on indicated metal brackets securely fastened to wall framing.
 - 3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.
- I. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
- J. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes to walls with adhesive.
 - 4. Seal space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
- K. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

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SECTION 07 8413
PENETRATION FIRESTOPPING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Penetrations in fire-resistance-rated walls.
 2. Penetrations in horizontal assemblies.

1.1 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site and related Work.

1.2 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work. Include the following.
1. For each type of penetration, provided product data for firestopping system by a single manufacturer throughout the project. Multiple manufacturer and multiple submissions by different trades for same type of penetration will not be reviewed. Refer to "Single Source Responsibility" in Quality Assurance below.

1.3 INFORMATIONAL SUBMITTALS

- A. Submittal:
1. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
 - a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- B. Sustainability Submittals:
1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. An installer trained and licensed by the manufacturer in the use of the materials and equipment to be employed in the Work.
 - a. A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
 - b. Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.
 - c. Source Limitations: Obtain penetration firestopping systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hilti, Inc.
 2. RectorSeal Corporation.
 3. Specified Technologies Inc.
 4. 3M Fire Protection Products.
 5. Tremco, Inc.; Tremco Fire Protection Systems Group.
 6. USG Corporation.

2.2 PERFORMANCE

A. Design Criteria:

1. For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
 - a. Fire-resistance-rated walls, including partitions, with fire-protection-rated openings.
 - b. Fire-resistance-rated floor and roof assemblies.
2. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
3. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - a. Penetrations located outside wall cavities.
 - b. Penetrations located outside fire-resistive shaft enclosures.
 - c. Penetrations located in construction containing fire-protection-rated openings.

- d. Penetrating items larger than 4-inch- diameter nominal pipe or 16 sq. in. in overall cross-sectional area.
4. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
 - a. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - b. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
 - c. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
5. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

2.3 MATERIALS

A. General:

1. **Compatibility:** Provide firestopping systems 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 firestopping manufacturer based on testing and field experience.

B. Penetration Firestopping:

1. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
2. **Penetrations in Fire-Resistance-Rated Walls:** Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - a. Fire-resistance-rated walls include fire walls fire-barrier walls and fire partitions.
 - b. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
3. **Penetrations in Horizontal Assemblies:** Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - a. Horizontal assemblies include floors and ceilings.
 - b. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 - c. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - d. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
4. **W-Rating:** Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
5. **Exposed Penetration Firestopping:** Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

6. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - a. Permanent forming/damming/backing materials, including the following:
 - 1) Slag-wool-fiber or rock-wool-fiber insulation.
 - 2) Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - 3) Fire-rated form board.
 - 4) Fillers for sealants.
 - 5) Firestopping putty.
 - b. Temporary forming materials.
 - c. Substrate primers.
 - d. Collars.
 - e. Steel sleeves.

C. Fill Material:

1. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
2. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
3. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
4. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
5. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
6. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
7. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
8. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
9. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

D. Mixing:

1. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Verify that firestopping is properly installed before concealing or enclosing firestopped area.

- B. Firestopping shall remain accessible until inspection and approval by governing authorities.

3.5 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.6 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

PENETRATION DESCRIPTION	UL CLASSIFIED SYSTEM		UL NUMBER	FILL MATERIAL
Firestop Systems with No Penetrating Items	C-AJ- C-BJ- F-A-	W-J- W-L-	0001-0999	Latex sealant Silicone sealant Mortar Intumescent putty
Firestop Systems for Metallic Pipes, Conduit, or Tubing	C-AJ- C-BJ- C-BK F-A- F-B-	F-C- W-J- W-K- W-L-	1001-1999	Latex sealant Silicone sealant Mortar Intumescent putty
Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing	C-AJ- C-BJ- F-A- F-B-	F-C- W-J- W-L-	2001-2999	Latex sealant Silicone sealant Intumescent putty Intumescent wrap strips Firestop device
Firestop Systems for Electrical Cables	C-AJ- C-BJ- F-A- F-B-	F-C- W-J- W-L-	3001-3999	Latex sealant Silicone sealant Intumescent putty Silicone foam
Firestop Systems for Cable Trays	C-AJ- C-BJ- F-A- F-B-	F-C- W-J- W-K- W-L-	4001-4999	Latex sealant Intumescent putty Silicone foam Pillows/bags

Firestop Systems for Insulated Pipes	C-AJ- C-BJ- F-A-	F-C- W-J- W-L-	5001-5999	Latex sealant Intumescent putty Intumescent wrap strips Silicone foam
Firestop Systems for Miscellaneous Electrical Penetrants	C-AJ- F-A- W-L-		6001-6999	Latex sealant Intumescent putty Mortar
Firestop Systems for Miscellaneous Mechanical Penetrations	C-AJ- F-C- W-J- W-L-		7001-7999	Latex sealant Mortar
Firestop Systems for Groupings of Penetrations	C-AJ- C-BJ- F-A F-C- W-J- W-L-		8001-8999	Latex sealant Mortar Intumescent wrap strips Firestop device Intumescent composite sheet.

END OF SECTION

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SECTION 07 8443

FIRE-RESISTIVE JOINT SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire resistant joint systems through fire resistance rated assemblies, consisting of adjacent wall and floor assemblies and the materials designed to prevent the spread of fire through wall and floor assemblies, including:
 - a. Floor to wall joint systems
 - b. Wall to wall joint systems
 - c. Head of wall joint systems
 - d. Fire-acoustical joint sealant

1.1 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.
- B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities indicated as determined by UL 2079.
- C. For fire resistant joint systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.3 ACTION SUBMITTALS

A. Product Data: Describe the properties of items to be used in the Work.

1. For each type of fire resistant joint system product indicated.

B. Shop Drawings: Show fabrication and installation of the Work. Include the following.

1. For each fire resistant joint system, show each kind of construction condition and relationships to adjoining construction.
2. Include design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
3. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire resistant joint system configuration for construction and penetrating items.
4. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular fire resistant joint condition, submit illustration, with modifications marked, approved by fire resistant joint system manufacturer's fire-protection engineer.

1.4 INFORMATIONAL SUBMITTALS

A. Submittal:

1. Product Schedule: For each joint firestopping system. Include location and design designation of qualified testing and inspecting agency.
 - a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by joint firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

B. Sustainability Submittals:

1. Refer to Division 01 Section "LEED Requirements" for requirements.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Product Certificates: Signed by manufacturers of fire resistant joint system products certifying that products furnished comply with requirements.

E. Product Test Reports: From a qualified testing agency indicating fire resistant joint system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installer: An installer trained and licensed by the manufacturer in the use of the materials and equipment to be employed in the Work.

B. Installer Qualifications: An experienced installer who has completed fire resistant joint systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

- D. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.
- E. Fire-Test-Response Characteristics: Provide fire resistant joint systems that comply with the following requirements and those specified in "Performance Requirements" Article:
 - 1. Fire resistant joint system tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for fire resistant joint systems acceptable to authorities having jurisdiction.
 - 2. Fire resistant joint systems are identical to those tested per UL 2079 Provide rated systems complying with the following requirements:
 - a. Fire resistant joint system products bear classification marking of qualified testing and inspecting agency.
 - b. Fire resistant joint systems correspond to those indicated by reference to fire resistant joint system designations listed by the following:
 - 1) UL in "Fire Resistance With Hourly Ratings for Joint Systems and Through-Penetration Firestop Systems."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fire resistant joint system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle materials for fire resistant joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire resistant joint systems when ambient or substrate temperatures are outside limits permitted by fire resistant joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate fire resistant joint systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Fire Resistive Joint System Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fire Trak Corp.

2. Hilti Construction Chemicals, Inc.
 3. Nelson Firestop Products.
 4. RectorSeal Corporation.
 5. Specified Technologies Inc.
 6. 3M Fire Protection Products.
 7. Tremco.
 8. USG Corporation
- B. Fire Resistive Acoustical Joint System Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Heckel Corp.
 2. Hilti Construction Chemicals, Inc.
 3. Johns Manville international
 4. Passive Fire Protection Partners
 5. Rectorseal
 6. STI
 7. USG Corporation

2.2 PERFORMANCE

- A. Design Criteria:
1. General:
 - a. Provide work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
 - b. Regulations: Conform with the requirements of the applicable Building Code as it pertains to engineering, design, fabrication and installation of system.
- B. Performance Requirements:
1. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities indicated as determined by UL 2079.
 - a. Load-bearing capabilities as determined by evaluation during the time of test.
 2. For fire resistant joint systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.
 3. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

2.3 MATERIALS

- A. General:
1. Provide materials to comply with the requirements of Division 01 Section "Sustainability Requirements".
 - a. Sealants and Adhesives to meet the VOC limits, Interior on-site applied only
 2. Compatibility: Provide fire resistant joint systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating fire resistant joint

systems, under conditions of service and application, as demonstrated by fire resistant joint system manufacturer based on testing and field experience.

3. Accessories: Provide components for each fire resistant joint system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by fire resistant joint system manufacturer and approved by the qualified testing and inspecting agency for fire resistant joint systems indicated. Accessories include, but are not limited to, the following items:
 - a. Permanent forming/damming/backing materials, including the following:
 - 1) Slag-/rock-wool-fiber insulation.
 - 2) Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - 3) Fire-rated form board.
 - 4) Fillers for sealants.
 - b. Temporary forming materials.
 - c. Substrate primers.
 - d. Safing Clips: Galvanized steel safing clips approved by manufacturer of safing insulation for holding safing insulation in place.

B. Fill Material:

1. Provide fire resistant joint systems containing the types of fill materials indicated in the Fire resistant joint System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
2. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
3. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated fire resistant joint system limits use to nonsag grade for both opening conditions.

C. Fire-Acoustical Joint Sealants:

1. Fire-Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and a component of a fire rated joint system. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. Movement capability in a rated fire resistive joint system to be 25 percent compression and 25 percent expansion.
 - a. Products with up to 0.25 inch compression or 0.25 inch extension: Subject to compliance with requirements, provide one of the following:
 - 1) Heckel Corp; Flame Seal.
 - 2) Hilti; CP601S.
 - 3) Johns Manville international; Fire Temp.
 - 4) John Wagner Associates; GrabberGuard.
 - 5) Passive Fire Protection Partners; 4100NS, 4800DW or 3600EX.
 - 1) STI; SpecSeal ES.
 - b. Products with up to 0.15 inch compression or 0.15 inch extension: Subject to compliance with requirements, provide one of the following:
 - 1) Rectorseal; MC/BF 150.

- 2) USG Corporation; SHEETROCK Acoustical Sealant.
- c. Uses: SL-15. Refer to Schedule at end of section for application.
- d. Warranty: 10 year.

2.4 FABRICATION

A. Mixing:

- 1. For those products requiring mixing before application, comply with fire resistant joint system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing fire resistant joint systems to comply with written recommendations of fire resistant joint system manufacturer.
- B. Priming: Prime substrates where recommended in writing by fire resistant joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fire resistant joint systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire resistant joint system materials. Remove tape as soon as possible without disturbing fire resistant joint system's seal with substrates.

3.3 FIRE RESISTANT JOINT SYSTEM INSTALLATION

- A. General: Install fire resistant joint systems to comply with "Performance Requirements" Article and fire resistant joint system manufacturer's written installation instructions and published drawings for products and applications indicated.

3.4 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by fire resistant joint system manufacturers and that do not damage materials in which openings occur.

3.5 FIELD QUALITY CONTROL

- A. Verify that firestopping is properly installed before concealing or enclosing firestopped area.
- B. Firestopping shall remain accessible until inspection and approval by governing authorities.

3.6 FIRE RESISTANT JOINT SCHEDULE

- A. Where UL-classified systems are indicated, they refer to the alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.

JOINT DESCRIPTION	UL SYSTEM	NOMINAL JOINT WIDTH	UL CLASSIFIED SYSTEMS	ASSEMBLY RATING	JOINT MATERIAL
Wall to Wall	WW-D	As Indicated	0001-0999 1000-1999 2000-2999 3000-3999 4000-4999	2 Hours minimum, not less than indicated	Latex Sealants Silicone Sealants
Floor to Wall	FW-D	As Indicated	0001-0999 1000-1999 2000-2999 3000-3999 4000-4999	2 Hours minimum, not less than indicated	Latex Sealants Silicone Sealants
Head of Wall	HW-D	As Indicated	0001-0999 1000-1999 2000-2999 3000-3999 4000-4999	2 Hours minimum, not less than indicated	Latex Sealants Silicone Sealants

END OF SECTION

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SECTION 07 9201
INTERIOR JOINT SEALANTS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Silicone joint sealants.
 2. Urethane joint sealants.
 3. Latex joint sealants.
 4. Acoustical joint sealants.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Samples:
1. Initial Selection: Submit for action. Furnish manufacturer's complete color selection showing full range of colors and finish characteristics. Furnish the following.
 - a. Color charts consisting of strips of cured sealants.
 2. Verification: Submit for action. Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Samples with joint sealants in 1/2 inch (13 mm) wide joints formed between two 6 inch (150 mm) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
1. Refer to Division 01 Section "LEED Requirements" for requirements.

PART 2 – PRODUCTS

2.1 PERFORMANCE

A. Design Criteria:

1. General:

- a. Provide work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
- b. Regulations: Conform with the requirements of the applicable Building Code as it pertains to engineering, design, fabrication and installation of system.

2.2 MATERIALS – GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Liquid-Applied Joint Sealants:

1. Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - a. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

C. Stain-Test-Response Characteristics:

1. Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food:

1. Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors of Exposed Joint Sealants:

1. Match Architect's samples.

2.3 MATERIALS

A. Silicone Joint Sealants:

1. Mildew-Resistant, Single-Component, Acid-Curing or neutral-curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Corning Corporation; 786 Mildew Resistant.
 - 2) Pecora Corporation: 898 Mildew-Resistant Silicone
 - 3) Momentive Performance Materials - Silicones; Sanitary SCS1700.
 - 4) Tremco Incorporated; Tremsil 200 Sanitary.
 - b. Uses: SL-16. Refer to Schedule at end of section for application.

B. Urethane Joint Sealants:

1. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) BASF Building Systems; Masterseal NP 2
 - 2) Pecora Corporation; Dynatred.
 - 3) Sika Corporation, Construction Products Division; Sikaflex - 2c NS.
 - 4) Tremco Incorporated; Dymeric 240 FC or Vulkem 227.
 - b. Uses SL-13. Refer to Schedule at end of section for application.

C. Latex Joint Sealants:

1. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GE Momentive, RCS20.
 - 2) Pecora Corporation; AC-20+
 - 3) Tremco Incorporated; Tremflex 834
 - b. Uses: SL-11. Refer to Schedule at end of section for application.

D. Acoustical Joint Sealants:

1. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) USG Corporation; SHEETROCK Acoustical Sealant.
 - b. Uses: SL-14. Refer to Schedule at end of section for application.

E. Miscellaneous:

1. Sealant Backing:
 - a. Provide sealant backings of material and type which are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - b. Primer: Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealer-substrate tests and field tests.
 - c. Cleaners for Nonporous Surfaces: Provide nonstaining, chemical cleaners of type which are acceptable to manufacturers of sealants and sealant backing materials, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.
 - d. Masking Tape: Provide nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
1. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
 2. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
 3. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 4. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
 5. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application SL-11: Interior non-moving exposed sealants.
1. Joint Location:
 - a. Interior non-moving exposed sealants in gypsum board drywall construction
 2. Joint Sealant: Acrylic Latex Sealant or siliconized acrylic latex.
 3. Joint-Sealant Color: Match Architect's sample.
- B. Joint-Sealant Application SL-13: Interior joints in horizontal traffic surfaces.
1. Interior Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in stone flooring.
 - c. Control and expansion joints in brick flooring.
 - d. Control and expansion joints in tile flooring.
 - e. Other joints as indicated.
 2. Joint Sealant: Urethane;
 - a. Multicomponent, nonsag, traffic grade, Class 25.
 3. Joint-Sealant Color: Match Architect's custom color.
- C. Joint-Sealant Application SL-14: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Location:
 - a. Joints in acoustically rated construction.
 - b. Other joints as indicated.
 2. Joint Sealant:
 - a. Acoustical.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- D. Joint-Sealant Application SL-16: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Sealant Location:
 - a. Tile and stone control and expansion joints in bathrooms, toilet rooms, and kitchens.
 - b. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - c. Joints between countertops, side and backsplashes, and adjoining walls.
 - d. Other joints as indicated.
 2. Joint Sealant:
 - a. Single component, nonsag, mildew resistant, acid curing silicone or neutral curing silicone.
 3. Joint-Sealant Color: Match Architect's sample.

END OF SECTION

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SECTION 08 1113

HOLLOW METAL DOORS AND FRAMES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Standard Interior doors.
 - a. Doors:
 - 1) Non-rated.
 - 2) Fire-rated.
 - b. Lights in Doors:
 - 1) Non-rated.
 - 2) Fire-rated.
 - 2. Standard Interior Frames:
 - a. Door frames:
 - 1) Non-rated.
 - 2) Fire-rated.
 - b. Borrowed lites:
 - 1) Non-rated.
 - c. Door frames with Sidelites.
 - 1) Non-rated.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Shop Drawings: Show fabrication and installation of the Work. Include the following.
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.

5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

- C. Schedule: Schedule of units, using same room designations shown on drawings.
1. Provide a schedule of hollow-metal work prepared by or under the supervision of supplier. Coordinate with final Door Hardware Schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sustainability Submittals:
1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and Acceptance Requirements: Deliver materials in manufacturer's original packaging with label indicating pertinent information identifying the item.
- B. Inspect products upon delivery for damage. Minor damage may be repaired, provided that refinished items are equal in all respects to new work and acceptable to the University's Representative. Otherwise, remove and replace damaged items as directed.
- C. Storage and Handling Requirements: Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide one of the following.
1. Amweld International, LLC.
 2. Ceco Door Products; an Assa Abloy Group company.
 3. Curries Company; an Assa Abloy Group company.
 4. LaForce, Inc.
 5. Pioneer Industries
 6. Republic Door and Frames
 7. Steelcraft; an Allegion company.

2.2 PERFORMANCE

A. Design Criteria:

1. General:
 - a. Provide work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
 - b. Regulations: Conform with the requirements of the applicable Building Code as it pertains to engineering, design, fabrication and installation of system.
2. Fire-Rated Assemblies:
 - a. Complying with California Standards Code Fire Door Assembly Test Standard 12-7-4 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
3. Smoke- and Draft-Control Assemblies:
 - a. Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Division 08 Section "Interior Glazing."

- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 FABRICATION

A. General:

1. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle.
2. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant.
3. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Standard Interior Hollow-Metal Doors:

1. General:

a. Cores:

1) Steel-Stiffened Door Cores:

- a) Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with insulation.

2) Fire Door Cores:

- a) As required to provide fire-protection ratings indicated.

b. Level/Model:

- 1) Refer to Interior Doors and Frames Types in this section.

c. Vertical Edges for Single-Acting Doors:

- 1) Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).

d. Edge Closures:

1) Top Edge:

- a) Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.

2) Bottom Edge:

- a) Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.

e. Astragals:

- 1) Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.
- 2) Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Standard Hollow-Metal Frames:

1. General:

- a. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
- b. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

- c. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
 2. Sidelight and Transom Bar Frames:
 - a. Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 3. Floor Anchors:
 - a. Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
 - 1) Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2) Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.
 - b. Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 4. Jamb Anchors:
 - a. Stud-Wall Type:
 - 1) Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 - 2) Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - a) Three anchors per jamb up to 60 inches (1524 mm) high.
 - b) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - c) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - d) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - 3) Compression Type:
 - a) Not less than two anchors in each frame.
 - 4) Postinstalled Expansion Type:
 - a) Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
 - b. Postinstalled Expansion Type for In-Place Concrete or Masonry:
 - 1) Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts.
 - 2) Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
 5. Door Silencers:
 - a. Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - b. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - c. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Stops and Moldings:
- a. Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
 - b. Single Glazed Lites:

- 1) Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - c. Multiple Glazed Lites:
 - 1) Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - d. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - e. Provide loose stops and moldings on inside of hollow-metal work.
 - f. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
- E. Hardware Preparation:
1. Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 2. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 3. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Interior Doors and Frames Types:
1. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
 2. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
 - a. Locations:
 - 1) Typical interior hollow metal doors and frames.
 - 2) Typical metal frames for wood doors.
 - b. Physical Performance: Level B according to SDI A250.4.
 - c. Doors:
 - 1) Type: As indicated in the Door and Frame Schedule.
 - 2) Thickness: 1-3/4 inches (44.5 mm).
 - 3) Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - a) Provide Metallic-coated steel sheet, with minimum A60 (ZF180) coating, at locations noted.
 - 4) Edge Construction: Model 2, Seamless.
 - 5) Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - d. Frames:
 - 1) Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - a) Provide Metallic-coated steel sheet, with minimum A60 (ZF180) coating, at locations noted.
 - 2) Construction: Full profile welded.
 - e. Exposed Finish: Prime for field painting.
- G. Miscellaneous:
1. Mullions and Transom Bars:
 - a. Join to adjacent members by welding or rigid mechanical anchors.

2. Grout Guards:
 - a. Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

2.5 FINISHES

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

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 3. Masonry and Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 5. In-Place Metal Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 6. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

- c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
- a. Non-Fire-Rated Steel Doors:
 - 1) Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - 2) Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - 3) Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
 - b. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - c. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.

3.2 ADJUSTING AND CLEANING

- a. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- b. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- c. Remove grout and other bonding material from hollow-metal work immediately after installation.
- d. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08 1416
FLUSH WOOD DOORS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Solid core flush wood doors with wood veneer faces.
 - a. Non-Rated
 - b. Fire Rated
 2. Openings:
 - a. Light.
 3. Shop priming flush wood doors for field painting.
 4. Factory finishing flush wood doors with wood veneer faces.
 5. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work. Include the following.
1. Include details of core and edge construction and trim for openings.
 2. Factory-finishing specifications.
- B. Shop Drawings: Show fabrication and installation of the Work. Include the following.
- a. Dimensions and locations of mortises and holes for hardware.
 - b. Dimensions and locations of cutouts.
 - c. Requirements for veneer matching.
 - d. Doors to be factory finished and finish requirements.
 - e. Fire-protection ratings for fire-rated doors.
- C. Schedules: Schedule of units, using same room designations shown on drawings.
1. Provide a schedule of door work prepared by or under the supervision of supplier. Coordinate with final Door Hardware Schedule.
- D. Samples:

1. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Doors for Transparent Finish: 8 by 10 inches (200 by 250 mm) square sample with door faces with solid wood edging representing typical range of color and grain for each species of veneer and solid lumber required.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
 1. Refer to Division 01 Section "LEED Requirements" for requirements.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Basis of Design: Subject to compliance with requirements, provide the following
 - 1) Marshfield Door Systems, Inc.
 - 2) Acceptable alternative manufacturers:
 - a)Oshkosh Architectural Door Company.
 - b)VT Industries Inc.

2.2 PERFORMANCE

- A. Design Criteria:
 1. General:
 - a. Provide work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
 - b. Regulations: Conform with the requirements of the applicable Building Code as it pertains to engineering, design, fabrication and installation of system.
 2. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
 - a. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
- B. Performance Requirements:
 1. Fire-Rated Wood Doors: Doors complying with California Standards Code Fire Door Assembly Test Standard 12-7-4 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

- a. Refer to drawings for fire rating of doors.
 - b. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - c. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - d. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
2. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
 3. WDMA I.S.1-A Performance Grade:
 - a. Heavy Duty unless otherwise indicated.

2.3 MATERIALS

- A. Particleboard-Core Doors:
 1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.
 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- B. Mineral-Core Doors:
 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
- C. Intumescent Fire and Smoke Materials:
 1. Fire rated openings as required by door and frame manufacture to comply with UL 10C.
 - a. Category A: Concealed intumescent.
 - b. Category B: Frame mounted intumescent.

2.4 FABRICATION

- A. General:
 1. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - a. Comply with NFPA 80 requirements for fire-rated doors.

2. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 - a. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- B. Veneer Faced Doors for Transparent Finish:
 1. Interior Solid-Core Doors:
 - a. Grade: Premium, with Grade A faces.
 - b. Species and Cut: Maple, rotary cut.
 - c. Match between Veneer Leaves: Book match.
 - d. Assembly of Veneer Leaves on Door Faces: Running match.
 - e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - f. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
 - g. Exposed Vertical and Top Edges: Same species as faces or a compatible species.
 - h. Core:
 - 1) Non-Rated: Particleboard.
 - 2) Fire-Rated: Mineral-core.
 - i. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
- C. Openings: Factory cut and trim openings through doors.
 1. Light Openings:
 - a. Trim openings with moldings of material and profile indicated.
 - b. Non-Rated Light Frames:
 - 1) Provide manufacturer's standard wood beads unless otherwise indicated.
 - a) Wood Species: Same species as door faces.
 - b) Profile: Flush rectangular beads.
 - c) At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
 - c. Fire-Rated Light Frames:
 - 1) Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated.
 - 2) Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.
 - d. Glazing:
 - 1) Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Interior Glazing."

2.5 FINISHES

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Shop Priming:
 1. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Division 09 Section "Interior Painting."
- C. Factory Finishing:
 1. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - a. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
 2. Factory finish doors that are indicated to receive transparent finish.
 3. Transparent Finish:
 - a. Grade: Custom.
 - b. Finish: WDMA TR-4 conversion varnish or TR-6 catalyzed polyurethane.
 - c. Staining: Clear stain to match (E).
 - d. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
 - e. Sheen: High Gloss.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Hardware: For installation, see Section 08 71 00 "Door Hardware."
- C. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated. Install fire-rated doors according to NFPA 80. Install smoke- and draft-control doors according to NFPA 105.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- F. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless

otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.

- a. Comply with NFPA 80 for fire-rated doors.

END OF SECTION

SECTION 08 3113

ACCESS DOORS AND FRAMES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior Access Doors:
 - a. Walls
 - b. Ceilings

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work. Include the following.
 - 1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation of the Work. Include the following.
 - 1) Include plans, elevations, sections, details, and attachments to other work.
 - 2) Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Schedules: Schedule of units, using same room designations shown on drawings.
 - 1. Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
- D. Samples:
 - 1. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. 3 inch x 5 inch (76.2 mm x 127 mm) minimum size, of each panel face material showing factory-finished color and texture.

1.4 INFORMATIONAL SUBMITTALS

A. Sustainability Submittals:

1. Refer to Division 01 Section "LEED Requirements" for requirements.

PART 2 – PRODUCTS

2.1 PERFORMANCE

A. Design Criteria:

1. General:

- a. Provide work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
- b. Regulations: Conform with the requirements of the applicable Building Code as it pertains to engineering, design, fabrication and installation of system.

2. Fire-Rated Access Doors and Frames:

- a. Units complying with California Standards Code Fire Door Assembly Test Standard 12-7-4 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1) NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
 - 2) NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 MATERIALS

A. Ferrous Materials:

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
3. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
4. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

B. Frame Anchors: Same type as door face.

C. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.3 FABRICATION

A. General:

1. Provide access door and frame assemblies manufactured as integral units ready for installation.
 2. Metal Surfaces:
 - a. For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
 3. Doors and Frames:
 - a. Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - b. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 - c. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
 - d. Provide mounting holes in frames for attachment of units to metal framing.
 - e. Provide mounting holes in frame for attachment of masonry anchors.
 4. Recessed Access Doors:
 - a. Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
 5. Latching Mechanisms:
 - a. Furnish number required to hold doors in flush, smooth plane when closed.
 - b. For cylinder locks, furnish two keys per lock and key all locks alike.
 - c. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.
- B. Access Doors and Frames for Walls and Ceilings:
1. Gypsum Board Walls and Ceilings:
 - a. Flush Access Doors with Concealed Flanges
 - 1) Assembly Description:
 - a) Fabricate door to fit flush to frame.
 - b) Provide frame with gypsum board for concealed flange installation.
 - 2) Locations: Wall and ceiling typical.
 - 3) Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
 - 4) Finish: Factory prime and field finish.
 - 5) Frame Material: Same material and thickness as door.
 - 6) Hinges: Manufacturer's standard.
 - 7) Hardware: Lock.
 - 8) Manufacturer
 - a) Castle GFRG / GFRC "Pop-Out" with Radius corner or approved equal.
 - b. Fire-Rated, Flush Access Doors with Concealed Flanges :
 - 1) Assembly Description:
 - a) Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal.
 - b) Provide self-latching door with automatic closer and interior latch release.
 - c) Provide frame with gypsum board for concealed flange installation.
 - 2) Locations: Walls, typical at fire rated walls.
 - 3) Fire-Resistance Rating: Not less than that of adjacent construction.
 - 4) Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage.
 - a) Finish: Factory prime and field finish.

- 5) Frame Material: Same material, thickness, and finish as door.
- 6) Hinges: Manufacturer's standard.
- 7) Hardware: Lock.
- 8) Gasketing: At wet areas only.

C. Access Doors and Frames for Acoustical Walls and Ceilings:

1. Provide doors above with the addition of following:
 - a. Uncoated Steel Sheet for Door: Double wall.
 - b. Acoustical Insulation in Door: 2 psf
 - c. Hinges: Piano hinge.
 - d. Door Gasket: Pemko "S-88"

D. Hardware:

1. Non Fire-Rated Doors:
 - a. Latch: Cam latch operated by screwdriver
 - b. Lock: Self-latch bolt operated cylinder lock.
 - 1) Lock Preparation: Prepare door panel to accept cylinder specified in Division 08 Section "Door Hardware."
2. Fire-Rated Doors:
 - a. Latch: Self-latching bolt operated by screwdriver
 - b. Lock: Self-latch bolt operated cylinder lock.
 - 1) Lock Preparation: Prepare door panel to accept cylinder specified in Division 08 Section "Door Hardware."

2.4 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Ferrous Metals:

1. Shop Priming:
 - a. Preparation for Paint Finish:
 - 1) Clean surfaces of dirt, grease, and loose rust or mill scale, including items fabricated from galvanized steel, if any, followed by a conversion coating of type suited to organic coating applied over it.
2. Baked Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
 - a. Organic Coating: Thermosetting modified acrylic enamel primer/topcoat system complying with AAMA 2603 except with minimum dry film thickness of 1.5 mils, medium gloss.
 - 1) Color: Match Architect's sample.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING

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

END OF SECTION

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SECTION 08 4114

INTERIOR ALUMINUM STOREFRONTS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Partition System
2. Door Frames

B. Related Sections: Requirements that relate to this section are included but not limited to the section below.

1. Division 01 Section "LEED Requirements".
2. Division 07 Section "Interior Joint Sealants".
3. Division 08 Section "Door Hardware" for hardware requirements.
4. Division 08 Section "Interior Glazing" for glass requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site and related Work.

1.3 ACTION SUBMITTALS

A. Product Data: Describe the properties of items to be used in the Work. Include the following.

1. Fabrication methods.
2. Finishing.
3. Accessories.

B. Shop Drawings: Show fabrication and installation of the Work. Include the following.

1. Elevations.
2. Detail sections of typical composite members.
3. Hardware mounting heights.
4. Anchorages and reinforcements.
5. Movement provisions.
6. Glazing details.

C. Samples:

1. Initial Selection: Furnish manufacturer's complete color selection showing full range of colors and finish characteristics. Furnish the following.
 - a. Material as requested by Architect.
2. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Extrusions: 12 inch (304.8 mm) long of each finish selected.
 - b. Sheet or Plate: 12 inch (304.8 mm) square in range of finish selected.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals: Refer to Division 01 Section "LEED Requirements" for sustainability Submittal requirements.
- B. Test and Evaluation Reports:

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following.
 1. Record documents.
 2. Sustainable design closeout documentation.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations authorities having jurisdiction. Obtain necessary approvals from all such authorities.
- B. Qualifications:
 1. Contractor: Contractor is responsible for quality control of the Work.
 2. Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.
 3. Installer: An installer trained in the use of the materials and equipment to be employed in the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and Acceptance Requirements: Deliver materials in manufacturer's original packaging with label indicating pertinent information identifying the item.
- B. Storage and Handling Requirements: Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.

1.8 PROJECT CONDITIONS

- A. Ambient Conditions: Proceed with the Work in accordance with manufacturer's requirements and instructions and any agreements or restrictions of the Pre-Construction Conference.
- B. Project Conditions: Field measure at location of the Work prior to preparation of the shop drawings. Include measurements of adjacent construction to which the Work must fit. Coordinate construction to ensure that actual opening dimensions correspond to fabricated dimensions of the Work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

PART 2 – PRODUCTS

2.1 PERFORMANCE

- A. Design Criteria:
 - 1. General:
 - a. Provide work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
 - b. Provide work to withstand thermal movement, design wind pressure, gravity loads, seismic loads, and movement of building structure without failure. Work to remain watertight, airtight and free from defects.
 - A.) Refer to performance requirements below.
 - c. Regulations: Conform with the requirements of the applicable Building Code as it pertains to engineering, design, fabrication and installation of system.
 - 2. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply

with ANSI Z 97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

- a. Subject to compliance with requirements, permanently mark safety glass with SGCC certification label or another certification agency acceptable to authorities having jurisdiction.

3. Performance Requirements

A.) General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction. Failure includes the following:

- 1.) Deflection exceeding specified limits.
- 2.) Thermal stresses transferring to building structure.
- 3.) Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
- 4.) Noise or vibration created by wind and by thermal and structural movements.
- 5.) Loosening or weakening of fasteners, attachments, and other components.
- 6.) Sealant failure.

B.) Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C.) Structural Loads:

1.) Seismic Performance: Storefront window system assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7-16 Chapter 13 and the 2019 California Building Code.

a.) The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b.) Storefront window system assembly design and installation shall accommodate relative displacement per ASCE/SEI 7-16 Chapter 13.5.9 without breakage or dislodgement.

D.) Deflection of Framing Members, Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2.2 MATERIALS – GENERAL

- A. Single Source Responsibility:
 - 1. Obtain work from a single manufacturer.
- B. Sustainable Requirements:
 - 1. Provide materials to comply with the requirements of Section 01 8113 “LEED Requirements”.

2.3 MATERIALS

- A. Aluminum: Provide alloy and temper and finish as required to produce the Work.
 - 1. Plate and Sheet: ASTM B 209, 6061-T6
 - 2. Extruded Bars, Rods, Wire, Shapes, and Tubes: ASTM B221, 6063-T52
- B. Glass and Glazing: Refer to Division 08 Section “Interior Glazing” for requirements.
- C. Miscellaneous:
 - 1. Fasteners: Aluminum, nonmagnetic stainless steel, or other materials warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors and other components.
 - 2. Brackets and Reinforcement: Where feasible, provide high-strength aluminum brackets and reinforcements; otherwise provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A 386.

2.4 FABRICATION

- A. General:
 - 1. Sizes of door and frame units, and profile requirements, are indicated on drawings. Variable dimensions are indicated, with maximum and minimum dimensions required to achieve design requirements and coordination with other work.
 - 2. Prefabrication: Before shipment to the project site, complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible. Disassemble components only as necessary for shipment and installation.
 - a. Preglaze door and frame units to greatest extent possible.
 - b. Do not drill and tap for surface-mounted hardware items until time of installation at project site.
 - c. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.

3. Fasteners: Conceal fasteners wherever possible.
4. Brackets and Reinforcements:
 - a. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125" thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard noncorrosive pressed-in splined grommet nuts.
5. Welding: Comply with AWS recommendations; grind exposed welds smooth and restore mechanical finish.
6. Reinforcing: Install reinforcing as required for hardware and necessary for performance requirements, sag resistance and rigidity.
7. Dissimilar Metals: Separate dissimilar metals with zinc chromate primer, bituminous paint, or other separator that will prevent corrosion.
8. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.
 - a. Uniformity of Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.

B. Storefront Framing System:

1. Provide inside-outside matched resilient flush-glazed storefront framing system with provisions for glass replacement.
2. Basis-of-Design Product:
 - a. Subject to compliance with requirements, the design is based on one of the following manufacturer's product.
 - A.) Kawneer Company, Inc., Trifab VG 450 Framing System 1-3/4" Sightline
 - b. Subject to compliance with requirements, the following manufacturer's product will be considered as equal.
 - A.) Wilson Partitions "Projected Profile"

C. Hardware:

1. Refer to Division 08 section "Door Hardware" for requirements.

D. Glazing:

1. Division 08 Section "Interior Glazing" for glass requirements.

2.5 FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

- B. Aluminum:
 - 1. Anodized Finish:
 - a. 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. Verification of Conditions: Examine and correct conditions of area to receive the Work prior to installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
 - 1. Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Provide proper support and anchor securely in place.
 - 2. Separate aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. Comply with requirements specified under paragraph "Dissimilar Materials" in the Appendix to AAMA 101-85.
- B. Frames:
 - 1. Drill and tap frames and apply surface-mounted hardware items.
 - 2. Comply with hardware manufacturer's instructions and template requirements.
 - 3. Use concealed fasteners wherever possible.
- C. Glass:
 - 1. Refer to Division 08 Section "Interior Glazing" for installation of glass and other panels indicated to be glazed into doors and framing, and not preglazed by manufacturer.

3.3 CLEANING

- A. At the end of each work day, remove unused materials, debris and containers from the site.

B. Construction Waste Management:

1. At the end of each work day, recycle or dispose of unused material, debris and containers in accordance with Division 01 Section "Construction Waste Management and Disposal."

3.4 PROTECTION

- A. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

END OF SECTION

SECTION 08 7000

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Provide all material, labor, equipment and services necessary to completely install all Building Hardware materials, accessories and other related items necessary to complete the Project as indicated by the Contract Documents.
- B. Related Sections: The following Project Manual Sections contain requirements that relate to this section:
 - 1. ALL DIVISION 00 SPECIFICATION SECTIONS.
 - 2. ALL DIVISION 01 SPECIFICATION SECTIONS.
 - 3. 07 9201 INTERIOR JOINT SEALANTS
 - 4. 08 1113 HOLLOW METAL DOORS AND FRAMES
 - 5. 08 1416 FLUSH WOOD DOORS
 - 6. 08 4114 INTERIOR ALUMINUM STOREFRONTS
 - 7. 09 9123 INTERIOR PAINTING

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site

1.3 REFERENCES

- A. Standards:
 - 1. In accordance with the following standards:
 - a. ADAAG Americans with Disabilities Act Accessibility Guidelines Buildings and Facilities.
 - b. ASAHC American Society of Architectural Hardware
 - c. BHMA Builders Hardware Manufacturers Association.
 - d. CBC California Building Code, 2016 Edition
 - e. DHI Door and Hardware Institute.
 - f. HMMA Hollow Metal Manufacturer's Association.
 - g. NFPA National Fire Protection Association.
 - h. UL Underwriter's Laboratories.
 - i. WHI Warnock Hersey Incorporated.

1.4 DEFINITIONS

- A. The following definitions apply to this Specification Section:

1. AFF Above Finished Floor.
2. "LABEL" Shall mean "FIRE ASSEMBLY" as defined in CBC Section 713.2.
3. LDW Less Door Width.
4. NRP Non Removable Pin.
5. POT Path of Travel (as defined by DSA/ACS and the CBC).

1.5 SUBMITTALS

A. Submit in accordance with Specification Section - SUBMITTAL PROCEDURES:

1. Product Data.
 - a. Submit manufacturer's technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish (including any custom colors), and other information necessary to show compliance with requirements.
 - b. Provide Key Control System submittal for review prior to fabrication or ordering. Submit manufacturer's full color range (including any standard, premium and custom colors) for selection by the Architect.
 - c. Keying Schedule: Submit separate detailed schedule indicating clearly how the University's final instructions on keying of locks has been fulfilled.
2. Shop Drawings – (Hardware Schedule):
 - a. Submit shop drawings (Hardware Schedule) showing fabrication and installation of the work of this section including plans, elevations, sections, details of components, and attachments to other units of work. Include the following information:
 - 1) Type, style, function, size and finish of each Hardware Item.
 - 2) Name and manufacturer of each item.
 - 3) Fastenings and other pertinent information.
 - 4) Location of each hardware set cross-referenced to indications on the drawings both on the floor plans and in door and frame (opening) schedule as prepared by the Architect.
 - 5) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 6) Mounting locations for hardware.
 - 7) Door and frame sizes and materials.
 - 8) Keying information.
3. Closeout Submittals:
 - a. Maintenance Data in accordance with Specification Section - PROJECT CLOSEOUT.
 - b. Operation Data in accordance with Specification Section - PROJECT CLOSEOUT.
 - c. Record Documents in accordance with Specification Section - RECORD DOCUMENTS.
 - d. Warranty in accordance with Specification Section - WARRANTIES.

1.6 QUALITY ASSURANCE

A. Meetings:

1. Pre-installation Conference: Scheduled by the Contractor prior to the start of

- work.
 - a. Review hardware schedule, products and installation procedures.
 - b. Review University's keying standards.
 - c. Coordinate the work with all other related work.
 - d. Identify potential problems that may impede planned progress and proper installation of work regarding quality of installation and warranty requirements.
- 2. Progress Meetings: Scheduled by the Contractor for the proper performance of the work.
 - a. Review proper installation of work progress.
 - b. Identify any installation problems and acceptable corrective measures.
 - c. Identify any measures to maintain or regain project schedule if necessary.
- 3. Final Inspection: Scheduled by the Contractor upon proper completion of the work.
 - a. Inspect and identify any problems that may impede issuance of warranties or guaranties.
 - b. Maintain installed work until the Notice of Completion has been executed.

1.7 DELIVERY, STORAGE, AND HANDLING

- 1. Products shall be stored above ground on level platforms, six (6) inches above ground, allowing air circulation under stacked units.
- 2. Provide secure lock-up for door hardware delivered to the Project, but not yet installed.

1.8 WARRANTY

- A. In accordance with Specification Section WARRANTIES. B.

Special Warranties:

- 1. Closers Ten (10) Years.
 - a. Exception: Electronic closers shall be two (2) years.
- 2. Exit Devices Three (3) Years.
- 3. All other hardware Two (2) Years.

1.9 MAINTENANCE A.

Extra Materials:

- 1. Furnish a complete set of specialized tools and maintenance instructions as needed for University's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products specified are from companies listed below, or approved equivalent. These products listed herein establish the size, pattern, color range and function selected by the Architect for this Project. Manufacturers listed as acceptable alternative manufacturers must still comply with the requirements of the products listed in order to be approved as an equivalent during the Submittal Process. If the acceptable alternative manufacturers listed are not approved during the Submittal Process due to non-compliance with the contract documents, then the Contractor shall submit product specified.
 - 1. Specified product manufacturer, or approved equivalent:

- | | | |
|----|---|-------------------|
| a. | Continuous Gear Hinges | ROTON |
| | 1) Acceptable alternative manufacturers
MARKAR | |
| b. | Hinges, Butts and Pivots | HAGER COMPANIES. |
| | 1) Acceptable alternative manufacturers | STANLEY HARDWARE. |
| c. | Locks (Locksets) | SCHLAGE |
| d. | Cylinders | SCHLAGE |
| | 1) RX-L9092TEU 17A | |
| e. | Exit / Panic Devices | VON DUPRIN. |
| | 1) VonDuprin "98/99" Series, at interior | |
| | 2) Hager Companies "4500" Series | |
| | 3) Sargent "80" Series | |
| f. | Overhead Closers | LCN |
| | 1) LCN "4011", "4111", and "4640" Series | |
| g. | Door Stops (Everywhere else) | IVES |
| | 1) Acceptable alternative manufacturer | TRIMCO. |
| h. | Thresholds | PEMKO. |
| | 1) Acceptable alternative manufacturer | HAGER COMPANIES. |

B. Products from other manufacturers not listed must submit in accordance with Specification Section - SUBSTITUTION PROCEDURES.

2.2 MATERIALS

A. General:

1. Base Metals: Produce hardware units of basic metal and forming method indicating using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified within this specification section for applicable hardware units for finish designations indicated.
2. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
3. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
4. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners.
 - a. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely.
 - b. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.3 MANUFACTURED UNITS

A. Hinges:

1. General:
 - a. Templates: Provide only template-produced units.
 - b. Provide Phillips flat-head screws complying with the following requirements:
 - 1) For metal doors and frames, install machine screws into drilled and tapped holes.
 - 2) Finish screw heads shall match surface of hinges or pivots.
 2. Butt:
 - a. Provide hinge pins as follows:
 - 1) Out-Swing Exterior Doors Non-removable pins.
 - 2) Out-Swing Corridor Doors with Locks Non-removable pins.
 - 3) Interior doors Non-rising pins.
 - 4) Tips: Provide flat button and matching plug, finished to match leaves.
 - b. Provide 3 hinges for doors with heights 61 to 90 inches, typ. u.n.o. c. Hinges shall be 4-1/2 inches for doors up to 41" wide.
 - 1) Width: Sufficient to clear frame and trim when door swings 180 degrees.
- B. Lock Cylinders and Keying:
1. Lock Cylinders:
 - a. Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
 2. Keying:
 - a. Review the keying system with the University and provide the type required (Master, grandmaster or great-grandmaster), either new or integrated with the University's existing keying system. Contact University of California, Merced, Locksmith Services for keying instructions.
 - 1) Provide Schlage Interchangeable Core Cylinders for all keyed locksets and exit devices with 1467 Keyway. University to provide all keying.
 - 2) Equip locks and cylinders for construction core pin tumbler inserts. Provide only temporary inserts for the construction period, and remove when directed.
 - a) Provide final cores and keys to the University. b. Key Blanks: Provide as directed by the University.
 - c. Provide keys manufactured from nickel silver only. d. Supply keys and blanks as follows:
 - 1) Supply 3 uncut change keys for each different change key code.
 - 2) Supply additional uncut keys as directed by the University.
 - e. Comply with University's instructions for master keying, and except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
 - 1) Permanently inscribe each key with number of lock that identifies cylinder manufacturer's key symbol, and notation, "DO NOT DUPLICATE."

C. Locks, Latches, and Bolts:

1. All doors shall be operable from within, without the use of a key by merely rotating the latching handle.

2. All doors in areas used by students shall be self-releasing type, operable from within without the use of a key or special knowledge or effort.
 3. Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.
 4. Lock Protectors:
 - a. Lock astragals shall be provided with internally threaded fasteners for flat head machine screws. No hex head or carriage bolt fasteners will be permitted.
 - b. Must be through bolted to door.
 5. Provide $\frac{3}{4}$ inch minimum throw of latch for mortise locks.
 6. Provide keyed dogging devices on doors equipped with exit devices.
 - a. Do not provide dogging on fire rated doors equipped with exit devices.
- D. Exit / Panic Devices:
1. Panic hardware shall comply with CCR Title 24, Part 12, Chapter 12-10-3.
 - a. The release mechanism shall be so designed that a horizontal force or less will actuate the release bar and latches applied in the travel.
 2. No surface mounted vertical rods are allowed.
 3. Provide certificate by independent testing laboratory that device meets ANSI/BHMA A156.3 - 1994 standards.
 4. Device shall bear UL label for fire and or panic as may be required.
 5. Removable Mullions:
 - a. Removable with single turn of building key, and securely reinstalled without need for key.
 - b. All removable mullions shall be steel or aluminum clad steel whether the opening is fire-rated or not.
- E. Closers and Door Control Devices:
1. Door closer cylinders shall be of high strength cast iron construction with double heat treated pinion shaft to provide low wear operating capabilities of internal parts throughout the life of the installation.
 - a. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory.
 2. Except as otherwise specifically indicated, comply with manufacturer's written recommendations for size of door control unit depending on size of door, exposure to weather, and anticipated frequency of use.
 - a. Where parallel arms are indicated for closers, provide closer unit one size larger than recommended for use with standard arms.
 - b. Effort to operate shall conform to CBC Section 1133B.2.5 accessibility requirements.
- F. Door Stops:
1. Coordinate the installation of backing in walls with the door supplier, aligned with the top and bottom of doors.
 2. All Floor Stops shall be installed within four (4) inches maximum from the face of wall, bollard or partition.

G. Thresholds:

1. Provide standard metal threshold unit of type, size, and profile as shown or scheduled.

H. Fasteners:

1. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.
2. Screws for butt hinges shall be flathead, countersunk, full-thread type.
3. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.
4. Provide expansion anchors for attaching hardware items to concrete or masonry.
5. All exposed fasteners shall have a Phillips head.
6. Finish of exposed screws to match surface finish of hardware or other adjacent work.
7. All exit devices and lock protectors shall be fastened to the door by means of sex bolts, or through bolts.

2.4 FINISHES

A. Hardware finishes:

1. General:
 - a. All hardware shall be satin chromium (US26D – 626) unless otherwise noted.
 - b. Provide push plates, pull plates and kick or armor plates in satin stainless steel (US32D – 630) unless otherwise noted.
 - c. Door closers shall be powder-coated to match other hardware, unless otherwise noted.
 - d. Aluminum items shall be finished anodized aluminum (US28 – 628), except thresholds that can be furnished as standard mill finish.
2. Match items to the manufacturer's standard color and texture finish for the latch and lock sets.
3. Provide finishes that match those established by BHMA or, if none established, match existing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site verification of conditions:

1. Prior to the execution of the work under this specification section, inspect the installed work executed under other sections of this Project Manual that affect the execution of work under this specification section.
 - a. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed in writing by the manufacturer.
2. Report unacceptable conditions to the Architect. Do not begin work until unacceptable conditions have been corrected.
3. Execution of work under this specification section shall constitute acceptance of existing conditions.

3.2 PREPARATION

A. Coordination:

1. Coordinate work under this specification section with work specified under other sections to ensure proper and adequate interface of work.
 - a. Coordinate electrical power needs for those hardware items requiring electrical interface.
 - b. Coordinate electrical alarm needs (security, fire/smoke detection) for those hardware items requiring electrical alarm interface.
2. Provide all required hardware templates.

B. Surface preparation:

1. Prepare surface in accordance with manufacturer's written instructions and recommendations.
2. Coordinate the blocking required for all wall mounted hardware.
3. Clean substrates of substances (oil, grease, rolling compounds, incompatible primers, loose mill scale, etc.) which could impair bond of materials specified within this section.

3.3 INSTALLATION

A. General:

1. In accordance with manufacturer's written instructions and recommendations unless specifically noted otherwise.
 - a. Hardware distributor shall assist and advise installer in correcting field problems arising during installation of hardware.
 - b. Hardware distributor shall be on the Project within 48 hours upon being notified by the Contractor.
 - c. Hardware distributor shall assist installer in the proper adjustment of all door closers, and other operating devices.
2. In accordance with approved submittals.
3. In accordance with Regulatory Requirements.
4. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by the Architect.
 - a. Steel Doors and Frames: "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
 - b. CBC 1004.3.1.
 - c. Door opening devices shall be installed at 30" minimum to 44" AFF maximum height per CBC Section 1133B.2.5.2.
5. Install each hardware item in compliance with the manufacturer's written instructions and recommendations. Where indicated and where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections.
 - a. Do not install surface-mounted items until finishes have been completed on the substrate involved.
6. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
7. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

3.4 ADJUSTING

A. Adjusting:

1. Adjust and check each operating item of hardware and each door to ensure proper operations or function of every unit.
 - a. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

3.5 SCHEDULES

- A. The hardware schedule should be used as a guide only. In case of omissions, provide hardware in accordance with that scheduled for a similar opening.

LEGEND:

MANUFACTURER	INITIALS
HAGER COMPANIES	HAG
MARKS USA	MRK
IVES HINGES	IVE
ROTON	RTN
SCHLAGE	SCH
TRIMCO	TRI
VON DUPRIN	VON

HDW: OFFICES W/O CARD 001 READER

3	EA	HINGE	BB1279	652	HAG
1	EA	OFFICE LOCK	L9050P 17A XL11-800	630	SCH
1	EA	WALL BUMPER	WS407CCV	630	IVE
3	EA	SILENCER	DT64	GRY	IVE

HDW:002 ROOMS WITH CARD READERS

3	EA	HINGE	BB1279	652	HAG
1	EA	LOCK	AD400	626	CBORD
1	EA	LOCK CORE SURFACE	23-030	626	SCH
1	EA	CLOSER	4011/4111	689	LCN
1	EA	WALL BUMPER	WS407CCV	630	IVE
3	EA	SILENCER	DT64	GRY	IVE

HDW:003 RM 127

1	EA	SURFACE CLOSER	4011/4111 (ST-2730)	689	LCN
1	SET	GASKETING	DOOR MFR		NPG

***USE EXISTING DOOR HARDWARE AND CARD READER JUST REPLACE CLOSER AND GASKETING

HDW:004 LAB

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3	EA	HINGE	BB1279	652	HAG
1	EA	LOCK	AD400	626	SCH
1	EA	LOCK CORE SURFACE	23-030	626	SCH
1	EA	CLOSER	4011/4111	689	LCN
1	EA	WALL BUMPER	WS407CCV	630	IVE
3	EA	SILENCER	DT64	GRY	IVE
1	EA	KICK PLATE	8400 10 X 2 LDW AS APPROVED BY	630	IVE
1	SET	GASKETING	DOOR MFR		NPG

LAB

HDW:005

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3	EA	HINGE	BB1279	652	HAG
1	EA	OFFICE LOCK	L9070P 17A XL11-800	630	SCH
1	EA	LOCK CORE SURFACE	23-030	626	SCH
1	EA	CLOSER	4011/4111	689	LCN
1	EA	WALL BUMPER	WS407CCV	630	IVE
3	EA	SILENCER	DT64	GRY	IVE
1	EA	KICK PLATE	8400 10 X 2 LDW AS APPROVED BY	630	IVE
1	SET	GASKETING	DOOR MFR		NPG

HDW:006 CBORD (Wireless Card Reader Head end)

1	EA	CONTROLLER WIRELESS	V1000RX		CBORD
1	EA	RECIEVER	485-PIM (ADL6722995)		CBORD

***CARD READER DOORS REQUIRE ADDITIONAL WIRELESS RECIEVER (PIM) WIRES HOMERUN TO 3U3 (IDF)

***L&A REQUIRED TO DETERMINE PLACEMENT OF PIM

***L&A REQUIRED TO PROGRAM BACK END OF READER SYSTEM FOR NEW LOCATIONS

***L&A PRIMUS FACE SHEET WILL BE REQUIRED TO PURCHASE CORES

***CBORD PRODUCTS MUST BE PURCHASED VIA CBORD

END OF SECTION

SECTION 08 8001
INTERIOR GLAZING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Interior Storefront Glass
 2. Fire-Rated Door Glazing
 3. Non-Rated Interior Glass

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site

1.3 QUALITY ASSURANCE

- A. Source Limitations for Glass: Obtain ultraclear float glass, tinted float glass, coated float glass and laminated glass from single source from single manufacturer for each glass type.
- B. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- C. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

1.4 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work. Include the following.
 - 1. Manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.
- B. Schedules:
 - 1. Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- C. Samples:
 - 1. Initial Selection: Submit for action. Furnish manufacturer's complete color selection showing full range of colors and finish characteristics. Furnish the following.
 - a. Sealant.
 - b. Gaskets exposed to view.
 - 2. Verification: Submit for action. Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. 12 inch (304.8 mm) square samples of each type of glass indicated except for clear single pane units.
 - b. 12 inch (304.8 mm) long samples of each color required for each type of sealant exposed to view.
 - c. 12 inch (304.8 mm) long samples of each color required (except black) for each type of gasket exposed to view.

1.5 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
 - 1. Refer to Division 01 Section "LEED Requirements" for requirements.
- B. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Sustainability Submittals:
 - 1. Submit manufacturer's product data or certification information for each of the following materials per Division 01 Section "LEED Requirements".
 - a. Adhesives and sealant VOC content for each product applied in the interior.
- D. Preconstruction adhesion and compatibility test report.

PART 2 – PRODUCTS

2.1 PERFORMANCE

- A. Design Criteria:
 - 1. General:

- a. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement and impact loading (where applicable), without failure including loss or breakage of glass, failure of gaskets, deterioration of glass and glazing materials and other defects in the work.
2. Glass Design:
 - a. Confirm glass thicknesses by analyzing Project loads and in-service conditions in accordance with ASTM E 1300. Provide glass lites for various size openings not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1) Design Impact Loads: As required by code.
 3. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - a. Glass Association of North America (GANA) "Glazing Manual" and "Sealant Manual".
 - b. Laminated Glass: "LSGA Design Guide", GANA'S "Glazing Manual" and "Laminated Glass Design Guide."
 4. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with ANSI Z 97.1 and testing requirements of 16 CFR Part 1201 for category II materials.
 - a. Subject to compliance with requirements, permanently mark safety glass with SGCC certification label or another certification agency acceptable to authorities having jurisdiction.
 - b. Label Requirements:
 - 1) General:
 - a)The permanent glass mark shall be visible in the right-hand corner when viewed from inside following installation
 - b)Color: White.
 - c)Shape: Circular, 3/4 inch (19 mm) max diameter.
 - d)Information:
 - 1) Name or trade mark of the manufacturer.
 - 2) Identifier of the product standard that glass conforms to.
 - 3) Certification label from the testing and inspection agency.
 - 2) Frameless Glazing:
 - a) Edge Distance: 2 inch (50.8 mm) (both directions).
 - 3) Framed Glazing:
 - a)Distance between the glass mark and the visible edge frame is to be 2 inch (50.8 mm) (both directions).
 - b)Monolithic or Laminated Glass:
 - 1) Mark stamped on face 2.
 - c)Double Glazed Units:
 - 1) Mark stamped on face 2 and 3.
 5. Fire-Rated Glazing: Provide glazing products which are tested and listed by UL, for the fire ratings required based on testing according to ASTM E 119 or UL 263.
 - a. Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

B. Performance Requirements:

1. Interior Locations:
 - a. Design Pressure Loading: 5 psf unless indicated otherwise in other specification sections.
 - b. Seismic Loading: Refer to Structural Drawings.
 - c. Safety Glazing: Provide safety glazing in locations indicated on the drawings and in locations as required by Local Building Code.

2.2 MATERIALS – GENERAL

- A. Single Source Responsibility:
 1. Obtain materials from a single manufacturer for each different product required.
- B. Sustainable Requirements:
 1. Provide materials to comply with the requirements of Division 01 Section “Sustainability Requirements”.

2.3 MATERIALS

- A. General:
 1. Sizes: Fabricate glass to sizes required for glazing openings, with edge clearances and tolerances required.
 2. Provide all exposed corners and edges with pencil edges, unless indicated otherwise.
 3. As indicated on the drawings.
- B. Primary Glass Products:
 1. Primary Glass Standard: Provide primary glass which complies with ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and, if applicable, form, finish, mesh and pattern.
 2. Clear Float Glass: Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select).
 - a. Manufacturers: Subject to compliance with requirements, provide one of the following.
 - 1) Guardian Industries Corp.
 - 2) LOF / Pilkington
 - 3) PPG Industries, Inc.
 3. Fire-Rated Glazing Material: Proprietary product in the form of clear flat sheets, permanently labeled with appropriate marks of testing and inspecting agency, acceptable to authorities having jurisdiction, showing product complies with installation indicated, and as follows:
 - a. Doors, Sidelights, Transoms and Borrowed Lites:
 - 1) Tested in compliance with ASTM E 119 or UL 263.
 - 2) California: Tested in compliance with California Building Code Section 716.3.
 - 3) Provide with safety rating, and temperature rise rating if required by authorities having jurisdiction.
 - b. Manufacturers: Subject to compliance with requirements, provide one of the following.

- 1) Safety And Fire Technology Inc. a division of O’Keeffe’s
- 2) SCHOTT North America, Inc.
- 3) Technical Glass Products
- 4) Vetrotech Saint-Gobain

C. Heat-Treated Glass Products:

1. Uncoated Clear Heat-Treated Float Glass: ASTM C 1048. Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.
 - a. Fully Tempered: Kind FT (fully tempered, having a minimum surface compression of 10,000 psi. (68,900 kPa)).
 - b. Manufacturing Process: By horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.

D. Elastomeric Glazing Sealants and Preformed Glazing Tapes:

1. General: Provide products of type complying with the following requirements:
 - a. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
 - b. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.
 - c. Elastomeric Sealant Standard: Provide manufacturer’s standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses. Refer to Division 7 Section “Joint Protection”.
 - d. Colors: Provide color of exposed sealants indicated or, if not otherwise indicated, as selected by Architect from manufacturer’s standard colors.

E. Miscellaneous Glazing Materials:

1. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.
2. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
3. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
4. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.
5. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.
6. Glazing Channels: Manufacturer recommended channel.
7. Pre-formed Wedge Strips. Manufacturer recommended channel.

PART 3 – EXECUTION

3.1 GLAZING, GENERAL

- a. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- b. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- c. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site.
- d. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- e. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer.
- f. Provide spacers for glass lites where length plus width is larger than 50 inches.
- g. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.

3.3 TAPE GLAZING

- a. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

3.4 GASKET GLAZING (DRY)

- a. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- b. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- c. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

- a. Clean glass at substantial completion.
- b. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- c. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- d. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances

do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

- e. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

END OF SECTION

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SECTION 08 8778
GLAZING SURFACE FILM

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Privacy Films

B. Related Sections: Requirements that relate to this section are included but not limited to the section below.

1. Division 01 Section "LEED Requirements".
2. Division 08 Section "Interior Glazing" for interior glass requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site and related Work.

1.3 ACTION SUBMITTALS

A. Product Data: Describe the properties of items to be used in the Work.

B. Shop Drawings: Show fabrication and installation of the Work. Include the following.

1. Location and type of glazing surface films.
2. Detailed installation of film, anchoring accessories, and sealant.

C. Samples:

1. Initial Selection: Furnish manufacturer's complete color selection showing full range of colors and finish characteristics.
2. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Glazing Film: 4 by 6 inch (101.6 mm by 152.4 mm) minimum samples for each type.
 - b. Anchoring Material: 2 inch (50.8 mm) minimum length.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals: Refer to Division 01 Section "Sustainability Requirements" for sustainability submittal requirements.
- B. Test and Evaluation Reports:
 - 1. Certify that glazing film meets or exceeds design and performance requirements.
 - 2. Certify that installer is approved by manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following.
 - 1. Maintenance Data:
 - 2. Warranty Documentation
 - 3. Record documents.
 - 4. Sustainable Design Closeout Documentation

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations authorities having jurisdiction. Obtain necessary approvals from all such authorities.
- B. Qualifications:
 - 1. Contractor: Contractor is responsible for quality control of the Work.
 - 2. Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.
 - 3. Installer: An installer trained in the use of the materials and equipment to be employed in the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and Acceptance Requirements: Deliver materials in manufacturer's original packaging with label indicating pertinent information identifying the item.
- B. Storage and Handling Requirements: Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.

1.8 PROJECT CONDITIONS

- A. Ambient Conditions: Proceed with the Work in accordance with manufacturer's requirements and instructions and any agreements or restrictions of the Pre-Construction Conference, including the following:
1. Do not apply glazing film when surface temperature is less than 40 degrees F (4 degrees C).

1.9 WARRANTY

- A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.
- B. Special Warranty: Submit written warranty signed by the manufacturer agreeing to repair or replace defective materials or workmanship during the following period beginning at the date of substantial completion.
1. Defects include but are not limited to peeling, cracking, discoloring, deteriorating, or failing to perform.
 2. Warranty Period: Manufacturer's warranty but not less than 10 years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Privacy Films.
1. Color / Pattern: As selected by Architect from manufacturer's full line.
 2. Manufacturers: Subject to compliance with requirements, provide one of the following.
 - a. 3M CRYSTAL "Glass Finishes"
 - b. LLumar "Privacy Matt Film"
 - c. Madico "View Control Film"

2.2 MATERIALS – GENERAL

- A. Single Source Responsibility:
1. Obtain materials from a single manufacturer for each different product required.
- B. Sustainable Requirements:
1. Provide materials to comply with the requirements of Division 01 Section "Sustainability Requirements".

2.3 MATERIALS

A. Decorative Film:

1. Color / Pattern: As selected by Architect from manufacturer's full line.
2. Manufacturers: Subject to compliance with requirements, provide the following.
 - a. 3M CRYSTAL "Glass Finishes"

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine and correct conditions of area to receive the Work prior to installation. Comply with the following requirements.

1. Examine glass and frames.
2. Verify that existing conditions are adequate for proper application and performance of film.
3. Verify glass is not cracked, chipped, broken, or damaged.
4. Verify that frames are securely anchored and free of deflects.
5. Do not proceed until unsatisfactory conditions have been addressed.

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

3.2 PREPARATION

A. Surface Preparation:

1. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
2. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
3. Protect adjacent surfaces.

3.3 INSTALLATION

A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.

3.4 FIELD QUALITY CONTROL

A. Field Inspection:

1. Inspect film against light-colored background from approximately 10 feet (3.048 m). Ensure appearance is uniform without streaks, bands, thin spots, and pinholes.
2. Remove and replace film with defects.

3.5 CLEANING

- A. Clean glass [and anchoring accessories] following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.
- B. Wash glazed surfaces and adjacent frames with soft cloth, clean water, and detergent recommended by film manufacturer.
- C. At the end of each work day, remove unused materials, debris and containers from the site.
- D. Construction Waste Management:
 1. At the end of each work day, recycle or dispose of unused material, debris and containers in accordance with Division 01 Section "Construction Waste Management and Disposal."

3.6 PROTECTION

- A. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

END OF SECTION

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SECTION 09 2116

GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gypsum board shaft-wall assemblies for the following:
 - a. Shaft-wall enclosures.
 - b. Chase enclosures.
 - c. Stair enclosures.
 - d. Horizontal enclosures.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section “Project Meetings”, with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Schedules: Schedule of units, using same room designations shown on drawings.
 - 1. Product Schedule:
 - a. Coordinate with the non-structural framing manufacturer and provide a table listing the partition type, submitted metal framing, submitted gypsum board products, UL number matching required fire rating, and limiting height of the partition with the submitted products.
 - b. Include a statement indicating that the submitted products and the installation will conform to the requirements of the UL test number.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
 - 1. Refer to Division 01 Section “LEED Requirements” for requirements.

1.5 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Provide mold resistant gypsum board in instances where storage of gypsum board in the building and/or installation of gypsum board commences prior to the building being fully enclosed with the permanent enclosure and weathertight.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 1) Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. CertainTeed
 - 2. G-P Gypsum.
 - 3. National Gypsum Company.
 - 4. USG Corporation.

2.2 PERFORMANCE

- A. Design Criteria:
 - 1. Fire-Resistance Ratings: Provide materials and construction identical to those of assemblies with fire-resistance ratings determined according to ASTM E 119 by a testing and inspecting agency.
 - 2. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
- B. Performance Requirements:
 - 1. Structural Performance Characteristics: Provide gypsum board shaft wall systems engineered to withstand the following lateral design loadings (air pressures), applied

transiently and cyclically, for maximum heights of partitions required, within the following deflection limits, verified by pretesting for deflection characteristics.

- a. Wall Deflection Limit:
 - 1) Gypsum Board Shaft Wall Assemblies: L/240 of partition height.
- b. Sound Attenuation Performance: Provide assemblies designed and pretested to achieve the following minimum ratings for sound transmission class (STC) per ASTM E 90.
- c. STC Rating: 47, unless indicated otherwise.

2.3 MATERIALS

A. Panel Products:

1. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces.
 - a. Type X: Manufacturer's proprietary liner panels with moisture-resistant paper faces.
 - 1) Core: 1 inch (25.4 mm) thick.
 - 2) Long Edges: Double bevel.
2. Gypsum Board:
 - a. As specified in Division 09 Section "Gypsum Board."

B. Non-Load-Bearing Steel Framing:

1. Framing Members:
 - a. Comply with ASTM C 754 for conditions indicated.
2. Steel Sheet Components:
 - a. Comply with ASTM C 645 requirements for metal.
 - b. Protective Coating: ASTM A 653/A 653M, G60 (Z180).

C. Auxiliary Materials:

1. General:
 - a. Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.
2. Trim Accessories:
 - a. Cornerbead, edge trim, and control joints of material and shapes specified in Division 09 Section "Gypsum Board" that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.
3. Gypsum Board Joint-Treatment Materials:
 - a. As specified in Division 09 Section "Gypsum Board."
4. Steel Drill Screws:
 - a. ASTM C 1002, unless otherwise indicated.
5. Screws:
 - a. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
6. Track Fasteners:
 - a. Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
7. Expansion Anchors:

- a. Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
 8. Power-Actuated Anchors:
 - a. Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
 9. Sound Attenuation Blankets:
 - a. 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.
 - b. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 10. Acoustical Sealant:
 - a. As specified in Division 07 Section "Joint Sealants."
 11. Galvanized Steel Reinforcing Strips:
 - a. Minimum 20 gauge, 5" wide.
- D. Gypsum Board Shaft-Wall Assemblies:
1. Basis-of-Design Product:
 - a. As indicated on Drawings by design designation of a qualified testing agency.
 2. Fire-Resistance Rating:
 - a. As indicated.
 3. STC Rating:
 - a. As indicated.
 4. Studs:
 - a. Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
 - b. Depth: As indicated.
 - c. Minimum Base-Metal Thickness: As recommended by Manufacturer for span and loading based on L/240 deflection. For walls with ceramic tile, plaster or wall hung cabinets, limit the deflection to L/360.
 5. Runner Tracks:
 - a. Manufacturer's standard J-profile track with long-leg length as standard with manufacturer and to allow for indicated deflections, but at least 2 inches (51 mm) long and in depth matching studs.
 - b. Minimum Base-Metal Thickness: As recommended by Manufacturer for anticipated loading.
 6. Firestop Tracks:
 - a. Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - b. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Cemco; FAS track.
 - 2) ClarkDietrich Building Systems: Blazeframe
 - 3) Fire Trak Corp.; Fire Trak.
 - 4) MarinoWare; FAS track.

- c. Component Products: Top runner deflection track combined with a tested sound, fire, and smoke gasket for head of wall joints. Manufacturers of sound, fire and smoke gasket, subject to compliance with the requirements, to be one of the following:
 - 1) Specified Technologies Inc. (STI); SpeedFlex.
- 7. Jamb Struts:
 - a. Manufacturer's standard J-profile strut with long-leg length of 3 inches (76 mm), in depth matching studs, and not less than 0.0329 inch (0.84 mm) thick.
- 8. Room-Side Finish:
 - a. As indicated.
- 9. Shaft-Side Finish:
 - a. As indicated.
- 10. Insulation:
 - a. Sound attenuation blankets.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
 - 1. Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:
 - a. ASTM C 754 for installing steel framing except comply with framing spacing indicated.

3.2 SCHEDULE

- A. Refer to "Gypsum Board and Cement Board Product Schedule" located after Division 09 Section "Gypsum Board" for schedule of gypsum board products.

3.3 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

- D. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Form control and expansion joints with space between edges of adjoining gypsum panels.
- G. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- H. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Installation Of Outlet Pads:
 - 1. Install the outlet box pads on the backsides of all electrical boxes, TV jack boxes and telephone outlet boxes in party walls and partitions indicated to be acoustically rated
 - 2. Brush or wipe construction dust and dirt from the box surfaces.
 - 3. If surfaces are contaminated with oil, etc wipe with xylene or toluene to remove oily residue.
 - 4. Place pads centered on the back of the boxes. Carefully mold and fold around conduit cable entering into the box.
 - 5. After gypsum drywall panels are in place, apply acoustical sealant round outlets to effect the seal of the box to the wall.
- K. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- L. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 - 1. Aluminum Trim: Install in locations indicated on Drawings.
 - 2. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840, which are to be approved by Architect for visual effect.
- M. Prefill open joints and damaged surface areas.
- N. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- O. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 3: Where indicated on Drawings.
 - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
 - 5. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
 - b. At all exposed ceiling locations.
 - c. At all specialty wall finishes including but not limited to wallcovering and graphics.
- P. Texture Finish Application: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.
- Q. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- R. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION

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SECTION 09 2216

NON-STRUCTURAL METAL FRAMING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing members for the following applications:
 - a. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
 - b. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).
 - c. Metal blocking.
 - d. Sound isolation hangers.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

A. Product Data: Describe the properties of items to be used in the Work.

B. Schedules: Schedule of units, using same room designations shown on drawings.

1. Product Schedule:

- a. Coordinate with the gypsum board manufacturer and provide a table listing the partition type, submitted metal framing, submitted gypsum board products, UL number matching required fire rating, and limiting height of the partition with the submitted product schedule.
- b. Include a statement indicating that the submitted products and the installation will conform to the requirements of the UL test number.

1.4 INFORMATIONAL SUBMITTALS

A. Sustainability Submittals:

1. Refer to Division 01 Section "LEED Requirements" for requirements.

- B. When non-structural metal framing is used in non-standard partition designs or to frame openings over 4' in width or special partition details, submit structural calculations. This includes partitions subject to additional loads including wall hung cabinets, paneling, grab bars and handrails. Structural calculations are to be prepared, signed, and sealed by a Structural Engineer Licensed in state of project location substantiating the Contractor's design.

1.4 CONDITIONS

A. Existing Conditions:

1. Examine project and compare it with the drawings and specifications. Thoroughly investigate and verify conditions under which the work is to be performed. No allowance will be made for extra work resulting from negligence or failure to be acquainted with all available information concerning conditions necessary to estimate the difficulty or cost of the work.
2. Field Measurements: Take and be responsible for field measurements as required. Report any significant differences between field dimensions and the contract document conditions to Architect.
3. Carefully coordinate work under this Section with that of the structural framing sections and details so that the interface between structural framing and nonstructural framing shall provide the lines and degree of finish shown and specified.

PART 2 – PRODUCTS

2.1 PERFORMANCE

A. Performance Requirements:

1. Interior Locations:
 - a. Design Pressure Loading: 5 psf
 - b. Seismic Performance: Wall assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7-16 Chapter 13 and the 2019 California Building Code.
 - 1) The term "withstand" means walls shall accommodate two percent relative seismic drift and shall remain in place when subjected to the seismic forces specified."
 - 2) Design studs, blocking and backing to support audio visual screens, white boards, display cases and other attached accessories.
2. Fire-Test-Response Characteristics:
 - a. For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
3. STC-Rated Assemblies:
 - a. For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to

ASTM E 413 by an independent testing agency. Use the thinnest gage acceptable to comply with the required performance characteristics.

4. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Gypsum Board Assemblies:
 - 1) Gypsum Board Partition Assemblies: L/240 of partition height.
 - 2) Gypsum Board Partition Assemblies with Tile Finish or cement plaster finish: L/360 of partition height.

2.2 MATERIALS

- A. Framing Members, Non-Load Bearing, General: Comply with ASTM C 754 for conditions indicated.
 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 2. Protective Coating:
 - a. Typical locations unless noted otherwise: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.
 - b. Pool areas, locker rooms and public shower areas: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized, unless otherwise indicated.
- B. Suspension System Components:
 1. Tie Wire:
 - a. ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
 2. Hanger Attachments to Concrete, provide one of the following:
 - a. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - b. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
 3. Wire Hangers:
 - a. ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162 inch (4.12 mm) diameter.
 4. Uplift Resistant Hangers:
 - a. Contractor shall be responsible for designing and providing a suspension/holddown system for all exterior soffit and/or ceiling areas capable of supporting the ceiling construction and resisting positive and negative wind pressures of 50 psf.
 - b. Suspension and framing members will be as required to satisfy criteria and will be their placement will be coordinated with other materials occupying the area above the soffit or ceiling.
 5. Carrying Channels:
 - a. Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2 inch (12.7 mm) wide flanges.

- b. Depth: 2 inch (51 mm) unless otherwise indicated on the drawings. Space and support channels as required by the loads.
 - 6. Slotted Channel Framing:
 - a. Cold-formed metal box channels (struts) complying with MFMA-4.
 - b. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).
 - c. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B or structural steel, Grade 33 (Grade 230); 0.0528-inch (1.35-mm) minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.
 - 7. Furring Channels (Furring Members):
 - a. Cold-Rolled Channels: 0.0538 inch (1.37 mm) bare-steel thickness, with minimum 1/2-inch- (12.7 mm) wide flanges, 3/4 inch (19.1 mm) deep.
 - b. Steel Studs: ASTM C 645.
 - 1) Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).
 - 2) Depth: As indicated on Drawings.
 - c. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.
 - 1) Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 - d. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.
 - 1) Configuration: Asymmetrical.
 - 8. Grid Suspension System for Ceilings:
 - a. ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - b. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Armstrong World Industries, Inc. "Drywall Grid Systems"
 - 2) Chicago Metallic Corporation "640-C, Fire Front 650-C, 660-C, Fire and Front 670-C Drywall Furring System" as required by the conditions shown.
 - 3) USG Corporation "Drywall Suspension System"
- C. Steel Framing;
- 1. Steel Studs and Runners:
 - a. Steel Studs and Runners: ASTM C 645.
 - 1) Minimum Base-Metal Thickness:
 - a) Typical locations: 0.0179 inch (0.45 mm).unless required by Performance Requirements.
 - b) Framing at walls with ceramic tile finish: 0.0312 inch (0.79 mm) minimum unless thicker material is indicated on Drawings.
 - c) Framing at walls with wall hung cabinets: 0.0312 inch (0.79 mm) minimum unless thicker material is indicated on Drawings.
 - d) Framing at walls with wall hung panels: 0.0312 inch (0.79 mm) minimum unless thicker material is indicated on Drawings.
 - 2) Depth: As indicated on Drawings.
 - b. Proprietary Steel Studs and Runners:
 - 1) Meet performance of ASTM C 645 requirements and provide equivalent performance to the standard studs and runners listed above.
 - 2) Minimum Base-Metal Thickness:
 - a) Typical locations: 0.015 inch (0.38 mm).unless required by Performance Requirements.
 - b) Framing at walls with ceramic tile finish: 0.025 inch (0.64 mm) minimum unless thicker material is indicated on Drawings.

- c) Framing at walls with wall hung cabinets: 0.025 inch (0.64 mm) minimum unless thicker material is indicated on Drawings.
- d) Framing at walls with wall hung panels: 0.025 inch (0.64 mm) minimum unless thicker material is indicated on Drawings.
- 3) Depth: As indicated on Drawings.
- 2. Head Joints and Runners: Provide one of the following Slip-Type Head Joints:
 - a. Single Long-Leg Runner System:
 - 1) ASTM C 645 top runner with deep flanges in thickness of 0.0296 inch but not less than required for the loads, installed with studs friction fit into top runner and with continuous bridging located within 12 inch (304.8 mm) of the top of studs to provide lateral bracing.
 - 2) Flange depth to be two times the slab deflection indicated, plus one inch, but shall be not less than 2 inch (50.8 mm).
 - b. Double-Runner System:
 - 1) ASTM C 645 top runners, inside runner with deep flanges in thickness of 0.0296 inch but not less than required for loads and fastened to studs, and outer runner sized to friction fit inside runner.
 - a) Flange depth to be two times the slab deflection indicated, plus one inch, but shall be not less than 2 inch (50.8 mm).
 - c. Seismic Drift - Slotted Deflection Track:
 - 1) Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness of 0.0329 inch (0.83566 mm) but not less than required for loads and in width to accommodate depth of studs.
 - 2) Products: Subject to compliance with requirements, provide one of the following:
 - 1) Sliptrack Systems "SLP-TRK"
 - 2) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
 - 3) Superior Metal Trim; Superior Flex Track System (SFT).
 - d. Firestop Tracks:
 - 1) Top Runner: Manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness of 0.0329 inch (0.83566 mm) but not less than required for loads and in width to accommodate depth of studs. Subject to compliance with requirements, provide one of the following:
 - a) Fire Trak Corp.; Fire Trak.
 - b) Cemco; FAS track.
 - c) ClarkDietrich Building Systems: BlazeFrame
 - d) Marino\Ware; FAS track.
 - 2) Component Products: Top runner deflection track combined with a tested sound, fire, and smoke gasket for head of wall joints. Manufacturers of sound, fire and smoke gasket, subject to compliance with the requirements, to be one of the following:
 - a) Specified Technologies Inc. (STI); SpeedFlex.
- 3. Flat Strap and Backing Plate:
 - a. Steel sheet for blocking and bracing.
 - b. Typical Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm) unless noted otherwise or if a thicker metal is required by load supported.
 - c. Minimum Base-Metal Thickness for Stair Handrail Mounting: 0.053 inch unless otherwise engineered by the contractor.

4. Cold-Rolled Channel Bridging:
 - a. 0.0538 inch (1.37 mm) bare-steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges.
 - b. Depth: 1-1/2 inches (38.1 mm).
 - c. Clip Angle: Not less than 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
 5. Hat-Shaped, Rigid Furring Channels:
 - a. ASTM C 645.
 - b. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm) unless noted otherwise.
 - c. Depth: As indicated on Drawings.
 6. Resilient Furring Channels:
 - a. 1/2 inch (12.7 mm) deep, steel sheet members designed to reduce sound transmission.
 - b. Configuration: Asymmetrical.
 7. Cold-Rolled Furring Channels:
 - a. 0.0538 inch (1.37 mm) bare-steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges.
 - b. Minimum Depth: 3/4 inch (19.1 mm).
 - c. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch (0.79 mm).
 - d. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
 8. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inch (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare-metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
- D. Sound Isolation:
1. Sound Isolation Clips for Furring Channels:
 - a. Manufacturers: Provide one of the following products:
 - 1) Kinetics Noise Control, Inc. "IsoMAX Clip"
 - 2) PAC International "RSIC-1"
 - 3) Pliteq, Inc. "Genie Clip"
 2. Sound Isolation Hanger for Wire-Tie Ceiling:
 - a. Manufacturers:
 - 1) Kinetics Noise Control, Inc. "Muta Hanger"
 - 2) PAC International; RSIC-WHI
 - 3) Sound Proofing Company Inc. "CI Series"
 3. Sound Isolation Hangers:
 - a. Provide hangers consisting of a steel frame containing a coil spring seated in a cup.
 - b. The cup is molded with a rod isolation bushing that passes through the hanger frame. Hangers shall be selected from a 0.75" static deflection series.
 - c. Spring diameters and hanger box lower hole size shall be large enough to permit the hanger rod to swing through a 30 deg arc before contacting the box and short circuiting the spring.
 - d. Hangers shall be manufactured with provision for bolting or attaching to the ceiling flat iron straps, wires, rods or steel runners.
 - e. Hangers shall be fail safe.
 - f. Products: Subject to compliance with requirements, provide one of the following:

- 1) Kinetics "Series SRH"
 - 2) Mason Industries "Series W30N"
 4. Sound Resilient Partition Isolation Pad:
 - a. Manufacturers:
 - 1) Kinetics Noise Control, Inc. "Resilient Partition Isolation Pad Wallmat"
- E. Miscellaneous:
1. General: Provide auxiliary materials that comply with referenced installation standards.
 - a. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
 2. Isolation Strip at Exterior Walls: Provide one of the following:
 - a. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - b. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.175 mm) thick, in width to suit steel stud size.

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 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
 1. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
 2. Install bracing at terminations in assemblies.
 3. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Deflection Firestop Track: Install to maintain continuity of fire-resistance-rated assembly indicated.
 - b. Deflection Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated. Head of wall fire resistive joint system is required.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- E. Direct Furring:
 - 1. Screw to framing, shim to provide plumb installation.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- F. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c. Shim to provide plumb installation.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
 - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of

furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 3. Do not attach hangers to steel roof deck.
 4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

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SECTION 09 2900a

GYPSUM BOARD

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior Gypsum Board:
 - a. Dry Areas:
 - 1) Type X
 - 2) Type C
 - b. Tiles Backer Panels:
 - 1) Moisture Resistant Gypsum Board

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section “Project Meetings”, with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Schedules: Schedule of units, using same room designations shown on drawings.
 - 1. Product Schedule:
 - a. Coordinate with the non-structural framing manufacturer and provide a table listing the partition type, submitted metal framing, submitted gypsum board products, UL number matching required fire rating, and limiting height of the partition with the submitted products.
 - b. Include a statement indicating that the submitted products and the installation will conform to the requirements of the UL test number.
 - c. Include a statement indicating that the submitted products and the installation will conform to the requirements of the STC ratings rated assemblies.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
 - 1. Refer to Division 01 Section “LEED Requirements” for requirements.

PART 2 – PRODUCTS

2.1 PERFORMANCE

A. Design Criteria:

1. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
2. STC-Rated Assemblies: For STC/NIC rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 MATERIALS

A. Interior Gypsum Board:

1. General:
 - a. Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
 - b. Manufacturers: Subject to compliance with requirements, provide one of the products listed in the attached Gypsum Board Schedule.
2. Regular Type:
 - a. Thickness: 5/8 inch (12.7 mm).
 - b. Long Edges: Tapered
3. Type X:
 - a. Thickness: 5/8 inch (15.9 mm).
 - b. Long Edges: Tapered
4. Type C:
 - a. Thickness: As indicated.
 - b. Long Edges: Tapered.

B. Tile Backing Panels:

1. Moisture Resistant Gypsum Board:
 - a. ASTM C 1278, with manufacturer's standard edges.
 - b. Product: Subject to compliance with requirements, provide one of the products listed in the attached Gypsum Board Schedule.
 - c. Core: Type X unless otherwise indicated.
 - d. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

C. Trim Accessories:

1. Interior Trim: ASTM C 1047.
 - a. Material, provide one of the following:
 - 1) Paper-faced galvanized steel sheet.
 - 2) Vinyl
 - a)Basis of Design: Subject to compliance with the requirements, provide Trim-Tex Drywall Products or approved equal, unless otherwise indicated.
 - b)ASTM D 1784-Rigid Poly and Compounds and Chlorinated Poly Compounds

- c) ASTM D 3678-Rigid Poly Interior-Profile Extrusions
 - d) ASTM E 84 -Achieve a Class A rating for Flame spread and smoke
 - b. Shapes:
 - 1) Corner Bead.
 - a) Paper-faced galvanized steel sheet corner bead.
 - b) Vinyl: Cornerbead to be "Rigid Corner Bead" as manufactured by Trim-Tex Drywall Products or approved equal.
 - 2) Bullnose bead.
 - 3) LC-Bead: J-shaped; exposed long flange receives joint compound.
 - 4) L-Bead: L-shaped; exposed long flange receives joint compound.
 - a) Paper-faced galvanized steel sheet L-bead.
 - b) Vinyl: L-Bead to have tear-away bead.
 - 5) L-Bead at gypsum board returns to exterior windows: Tear Away Edge Bead: Provide Trim-Tex "Tear Away 'L' Bead" at ends of gypsum board that abuts window frames. Bead shall be fabricated of rigid PVC conforming to ASTM D1784, D3678, Class II and C1047. Tear away bead shall have a full 5/16" tear-off leg which acts as a guide for taping knife as well as protective masking for mudding and painting. When finished the leg shall be torn off.
 - 6) U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - 7) Expansion (control) joint.
 - 8) Curved-Edge Cornerbead: With notched or flexible flanges.
 - c. Vinyl Accessories:
 - 1) Adhesive: Vinyl trim manufacturers approved spray adhesive.
2. Aluminum Trim:
- a. Extruded accessories of profiles and dimensions indicated.
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Fry Reglet Corp.
 - 2) Gordon, Inc.
 - 3) Pittcon Industries.
 - c. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
 - d. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
3. Deflection Bead:
- a. Wall Mounted Deflection Bead.
 - a) For deflection of up to 7/16"
 - b) Manufacture: Trim-Tex "Wall Mounted Deflection Bead"
 - b. Ceiling Mounted Deflection Bead.
 - 1) For deflection of up to 3/4 inch use Ceiling Mounted Deflection Bead.
 - 2) Manufacture: Trim-Tex "Ceiling Mounted Deflection Bead"
- D. Joint Treatment Materials:
- 1. General:
 - a. Comply with ASTM C 475/C 475M.
 - 2. Joint Tape:
 - a. Interior Gypsum Wallboard: Paper.
 - b. Exterior Gypsum Soffit Board: Paper.
 - c. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - d. Tile Backing Panels: As recommended by panel manufacturer.

3. Joint Compound for Interior Gypsum Wallboard:
 - a. For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - b. Prefilling: At open joints, beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - c. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - 1) Use setting-type compound for installing paper-faced metal trim accessories.
 - d. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - e. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - f. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
 4. Joint Compound for Tile Backing Panels:
 - a. Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
- E. Miscellaneous:
1. General:
 - a. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
 2. Steel Drill Screws:
 - a. ASTM C 1002, unless otherwise indicated.
 - b. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - c. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
 3. Sound Attenuation Blankets:
 - a. 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.
 - b. Fire-Resistance-Rated Assemblies:
 - 1) Comply with mineral-fiber requirements of assembly.
 4. Outlet Box Pads:
 - a. Provide Lowry's Outlet Box Pads, as manufactured by Harry A. Lowry and Associates, Sun Valley, CA to seal the backsides of all electrical boxes, TV jacks and telephone outlet boxes to reduce air transmitted sound in all partitions with insulation.
 - b. Outlet pads shall be made of grey polybutene-butyl, and inert fillers.
 5. Fire Rated Outlet Box Pads:
 - a. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products by one of the following:
 - 1) Hilti "FS Pads"
 - 2) International Protective Coatings Corp. "Type 1077 Putty Pads"
 - 3) 3M "Type MPP-4S+ Moldable Putty Pads"
 - 4) Nelson Firestop Products "Type FSP Firestop Putty Pads"
 - 5) Specified Technologies, Inc. "Type SpecSeal Putty Pads"
 - 6) The Rectorseal Corp. "Metacaulk Fire Rated Putt Pads"
 6. Acoustical Sealant:
 - a. As specified in Division 07 Section "Joint Sealants."

7. Fire Rated Joint Systems:
 - a. As specified in Division 07 Section "Fire-Resistive Joint Systems" for fire rated perimeter joints.
8. Thermal Insulation:
 - a. As specified in Division 07 Section "Thermal Insulation."

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.

3.2 ATTACHMENTS

- A. Gypsum Board Product Schedule following this section.

3.3 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Form control and expansion joints with space between edges of adjoining gypsum panels.
- G. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.
 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- H. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Installation Of Outlet Pads:
1. Install the outlet box pads on the backsides of all electrical boxes, TV jack boxes and telephone outlet boxes in party walls and partitions indicated to be acoustically rated
 2. Brush or wipe construction dust and dirt from the box surfaces.
 3. If surfaces are contaminated with oil, etc wipe with xylene or toluene to remove oily residue.
 4. Place pads centered on the back of the boxes. Carefully mold and fold around conduit cable entering into the box.
 5. After gypsum drywall panels are in place, apply acoustical sealant round outlets to effect the seal of the box to the wall.
- K. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- L. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
1. Aluminum Trim: Install in locations indicated on Drawings.
 2. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840, which are to be approved by Architect for visual effect.
- M. Prefill open joints and damaged surface areas.
- N. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- O. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. Level 3: Where indicated on Drawings.
 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
 5. Level 5: Where wallcovering or specialty finishes, such as branding or wall graphics, occur.
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
 - b. At all exposed ceiling locations.
 - c. At all specialty wall finishes including but not limited to wallcovering.
- P. Texture Finish Application: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.
- Q. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- R. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION

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SECTION 09 2900b
GYPSUM BOARD AND CEMENT BOARD
PRODUCT SCHEDULE

PART 1 – GENERAL

1.1 SUMMARY

- A. This Gypsum and Cement Board Schedule includes:
 - 1. Gypsum Board in Dry Areas
 - a. Type X
 - b. Type C
 - c. Regular
 - 2. Tiled Areas
 - a. Limited Water Exposure Area Locations: Moisture Resistant Gypsum Board
 - 3. Shaft Wall Liner Board

- B. Gypsum Board Products Not Included/addressed in this Schedule:
 - 1. Gypsum board roofing substrate and cover boards.
 - 2. Board products used in swimming pools, hot tubs, commercial kitchens.
 - 3. Gypsum and cement board floor and countertop underlayments.

- C. Definitions: Wet area and limited water exposure as defined below are from the Tile Council of North America, Inc. (TCNA).
 - 1. Limited Water Exposure Area: Surfaces that are subjected to moisture or liquids but do not become soaked or saturated due to the system design or the time exposure. Examples include: residential bathroom floors and foyers, residential bathroom vertical surfaces including tub surrounds without a shower head, and kitchen countertops.

- D. Standards and Codes: The following standards include information pertinent to the use of drywall in the scheduled applications:
 - 1. Gypsum Association GA-223-04
 - 2. ASTM C1396 and ASTM C1178

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. The following product manufacturers are listed in the schedule:
1. Gypsum Board:
 - a. G-P Gypsum.
 - b. National Gypsum Company.
 - c. USG Corporation.
- B. The following project manufacturers are not listed in the table, but can be submitted as a substitution request:
1. CertainTeed.
 2. Lafarge.

2.2 FINISHING

- A. Tile Finishes: Tile finishing is to be performed according the TCNA.
- B. Paint Finishes: Gypsum board products listed in this schedule for exposed use may receive a paint finish without special preparation with the following exception:
1. The Georgia Pacific DensShield Tile Backer cannot be painted. If a tile wainscot is used in a shower application, the untiled upper portion must consist of a DensArmor Plus paintable product.
 2. Painting drywall products with taped joints can exhibit variations in paint finish due to the difference in absorption between the board and the taped joint. This is generally true of all drywall. Two coats are required for all drywall to avoid a difference in appearance. (“Spray and back roll” technique is considered one coat.)

2.3 GYPSUM BOARD IN DRY AREAS

- A. Interior Gypsum Board in Dry Areas: Drawing Designation: Gypsum Board

Applications/Uses	Description	Manufacturer	Product	Type	Thick-ness
Interior Walls & Ceilings; fire rated and non fire rated applications	Gypsum Board	Georgia Pacific	Toughrock Fireguard Gypsum	Type X	5/8 inch
	Gypsum Board	National Gypsum	Gold Bond Fire Shield	Type X	5/8 inch
	Gypsum Board	USG	Sheetrock Fire Code	Type X	5/8 inch

Interior Walls & Ceilings; fire rated and non fire rated applications	Gypsum Board	Georgia Pacific	Toughrock Fireguard Gypsum	Type C	5/8 inch
	Gypsum Board	National Gypsum	Gold Bond Fire Shield	Type C	5/8 inch
	Gypsum Board	USG	Sheetrock Fire Code C	Type C	5/8 inch
Interior Walls & Ceilings; non fire rated applications	Gypsum Board	Georgia Pacific	Toughrock	Regular	5/8 inch
	Gypsum Board	National Gypsum	Gold Bond	Regular	5/8 inch
	Gypsum Board	USG	Sheetrock	Regular	5/8 inch

2.4 TILED AREAS

A. Gypsum Tile Backer Board: Drawing Designation: Moisture Resistant Gypsum Board

Applications/Uses	Description	Manufacturer	Product	Type	Thickness
Limited Exposure Areas: Locations indicated to receive tile with limited water exposure; walls and ceilings.	Moisture Resistant Gypsum	Georgia Pacific	ToughRock Mold-Guard	Type X	5/8 inch
	Moisture Resistant Gypsum	National Gypsum	Gold Bond XP Wall Board	Type X	5/8 inch
	Moisture Resistant Gypsum	USG	Mold Tough Panels	Type X	5/8 inch

2.5 SHAFT WALL LINER BOARD

A. Shaft Wall Gypsum Liner Board: Drawing Designation: Gypsum Board Shaftwall

Applications/Uses	Description	Manufacturer	Product	Type	Thickness
Shaft Wall Liner Board Limited water exposure.	Mold and Moisture Resistant Liner Board	Georgia Pacific	Dens Glass Ultra	Type X	1 inch
	Mold and Moisture Resistant Liner Board	National Gypsum	Gold Bond E ² XP Extended Exposure Shaft Liner	Type X	1 inch
	Mold and Moisture Resistant Liner Board	USG	Sheetrock Glass-Mat Liner Panels	Type X	1 inch

B. Shaft Wall Finish Gypsum Board: Provide appropriate gypsum board selected from above applications.

END OF SECTION

SECTION 09 3000

TILING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceramic tile.
 - 2. Metal edge strips.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Samples:
 - 1. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.]
 - 1) Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inch (304.8 mm) square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
 - b. Full-size units of each type of trim and accessory.
 - c. Stone thresholds in 6 inch (152.4 mm) lengths.
 - d. Metal edge strips in 6 inch (152.4 mm) lengths.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
 - 1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following.
 - 1. Operation and Maintenance Data:
 - a. Maintenance Manual: Assemble into binder.
 - 1) Maintenance Practices: Manufacturer's recommended maintenance practices describing the materials, devices and procedures to be followed in cleaning and maintaining the Work.
 - 2. Record documents.
 - 3. Sustainable Design Closeout Documentation

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Submit the following to the Owner.
 - 1. Extra Stock Material: Furnish for each size, pattern and color installed in the Work. Deliver in manufacturer's original packaging and store at the project site where directed by the Owner. Furnish and deliver the following:
 - a. Materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1) Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2) Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

- a. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations authorities having jurisdiction. Obtain necessary approvals from all such authorities.
- b. Qualifications:
 - 1) Contractor: Contractor is responsible for quality control of the Work.
 - 2) Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.
 - 3) Installer: An installer trained in the use of the materials and equipment to be employed in the Work.
- B. Mockups:
 - 1. General:
 - a. Use the same installation methods and materials as required for the Work.
 - b. Schedule construction so that it may be reviewed, and any necessary adjustments made, prior to commencing fabrication of the Work.
 - c. When accepted, mock-up shall serve as the standard for materials, workmanship, and appearance throughout the Project.
 - d. Construction shall proceed only after acceptance of the on-site visual mockup.

- e. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 2. Provide the following:
 - a. On Site Visual Mockup:
 - 1) Dry Mock Up:
 - a) 10 sq. feet for each type and color.
 - b) Provide full range of tile for review.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- a. Deliver and Acceptance Requirements: Deliver materials in manufacturer's original packaging with label indicating pertinent information identifying the item.
 - 1) Comply with requirements in ANSI A137.1 for labeling tile packages.
 - b. Storage and Handling Requirements: Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.
 - 1) Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
 - 2) Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
 - 3) Store liquid materials in unopened containers and protected from freezing.
- Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding

PART 2 – PRODUCTS

2.1 PERFORMANCE

- A. Design Criteria:
 - 1. Standards:
 - a. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - b. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 MATERIALS - GENERAL

- A. Single Source Responsibility:
 - 1. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 - a. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

2. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
3. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
 - a. Ceramic tile.
 - b. Joint sealants.
 - c. Metal edge strips.

2.3 MATERIALS

A. Tile Type:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
2. Grout: Refer to Architectural drawings.

B. Bonding Materials:

1. Latex-Portland Cement Mortar (Thin Set):
 - a. ANSI A118.4.
 - b. Manufacturers: Subject to compliance with requirements, provide one of the following.
 - 1) Custom Building Products "Megaflex"
 - 2) Laticrete International, Inc "Laticrete 253"
 - 3) MAPEI Corporation "Ultraflex"
 - 4) TEC; a subsidiary of H. B. Fuller Company ""Full Flex"
 - c. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 - d. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

e. Grout Materials:

- 1) Polymer-Modified Tile Grout:
 - a) ANSI A118.7.
 - b) Manufacturers: Subject to compliance with requirements, provide one of the following unless indicated in drawings.
 - 1) Custom Building Products "Polyblend Grout"
 - 2) Laticrete International, Inc. "Polyblend Tile Grout"
 - 3) MAPEI Corporation "Ultra-Color Plus"
 - 4) TEC; a subsidiary of H. B. Fuller Company "AccuColor Grout"
 - c) Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

C. Miscellaneous:

1. Trowelable Underlayments and Patching Compounds:
 - a. Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
2. Metal Edge Strips:
 - a. Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for

- flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
3. Temporary Protective Coating:
 - a. Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 - 1) Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
 - 2) Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
 4. Tile Cleaner:
 - a. A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
 5. Grout Sealer:
 - a. Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
- D. Mixes:
1. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
 2. Add materials, water, and additives in accurate proportions.
 3. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
1. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards that apply to type of setting and grouting materials and methods indicated.
 2. TCNA Installation Guidelines: TCNA "Handbook for Ceramic Tile Installation"; comply with TCNA installation methods indicated.
 3. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
 4. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-

- in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
5. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
 6. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 7. Joint Widths: 1/16 inch unless otherwise indicated.
 8. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
 9. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - a. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 10. Metal Edge Strips: Install [at locations indicated] [where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile] [where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated].
 11. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
 12. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
 13. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
 14. Review tile sealer specifications with tile manufacturer for compatibility.
 15. Preseal all natural stone tiles prior to installation.
 16. Provide two final sealer coats after tile installation.

3.2 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Metal Studs or Furring:
 1. For use in dry areas only.
 - a. Tile sized less than 15 inches.
 - 1) Thin-set mortar on gypsum board.
 - a)TCNA Installation Method: TCNA W243
 - b)Bond Coat: Latex- portland cement mortar.
 - c)Tile: Refer to Drawings.
 - d)Grout - Typical: Polymer-modified grout.

3.3 CLEANING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

- B. At the end of each work day, remove unused materials, debris and containers from the site.

- C. Construction Waste Management:
 - 1. At the end of each work day, recycle or dispose of unused material, debris and containers in accordance with Division 01 Section "Construction Waste Management and Disposal."

3.4 PROTECTING

- A. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.
 - 1. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
 - 2. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
 - 3. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION

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SECTION 09 5113
ACOUSTICAL PANEL CEILINGS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Acoustical panels and exposed suspension systems for ceilings.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Shop Drawings: Show fabrication and installation of the Work. Include the following.
1. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - a. Ceiling suspension system members.
 - b. Method of attaching hangers to building structure.
 - 1) Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - c. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - d. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48).
- C. Samples:
1. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Acoustical Panel: Set of 6 inch (150 mm) square Samples of each type, color, pattern, and texture.
 - b. Exposed Suspension-System Members, Moldings, and Trim: Set of 6 inch (150 mm) long Samples of each type, finish, and color.

1.4 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal:
 - 1. For design of seismic restraints and attachment devices.
- B. Sustainability Submittals:
 - 1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following.
 - 1. Maintenance Data:
 - a. Maintenance Manual: Assemble into binder.
 - 1) Maintenance Practices: Manufacturer's recommended maintenance practices describing the materials, devices and procedures to be followed in cleaning and maintaining the Work.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Submit the following to the Owner.
 - 1. Extra Stock Material: Furnish for each size, pattern and color installed in the Work. Deliver in manufacturer's original packaging and store at the project site where directed by the Owner. Furnish and deliver the following:
 - a. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed but not more than 150 square feet. Full boxes to be provided with product labels.

PART 2 – PRODUCTS

2.1 PERFORMANCE

- A. Design Criteria:
 - 1. Seismic Performance: Ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 2. Fire-Test-Response Characteristics: As determined by testing identical materials applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - 1) Class A / Class I:
 - a) Flame-Spread Index: 0 to 25.
 - b) Smoke-Developed Index: 0 to 450.
- B. Performance Requirements:
 - 1. Interior Locations:
 - a. Design Pressure Loading: 5 psf

- b. Seismic Loading: Refer to Structural Drawings.

2.2 MATERIALS

A. Acoustical Panels

1. Glass-Fiber-Based Panels:

- a. Made with binder containing no urea formaldehyde.
- b. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment:
- c. Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21

2. Acoustical Panel Standard:

- a. Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
- b. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

3. Stone Wool Panels:

- a. Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

4. Basis-of-Design Product: Match Existing (E) ceiling tiles.

B. Metal Suspension Systems:

1. Metal Suspension-System Standard:

- a. Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

2. Finishes and Colors, General:

- a. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- b. Provide manufacturer's standard factory-applied finish for type of system indicated.
- c. High-Humidity Finish:
 - 1) Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

3. Attachment Devices:

- a. Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated.
- b. Comply with seismic design requirements.
- c. Anchors in Concrete:
 - 1) Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as

- determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
- a) Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - 2) Power-Actuated Fasteners in Concrete:
 - a) Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
 - 4. Wire Hangers, Braces, and Ties:
 - a. Provide wires complying with the following requirements:
 - 1) Typical except as noted below: Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2) Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
 - b. Seismic:
 - 1) Seismic Stabilizer Bars:
 - a) Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
 - 2) Seismic Struts:
 - a) Manufacturer's standard compression struts designed to accommodate seismic forces.
 - 3) Seismic Clips:
 - a) Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.
 - 5. Basis-of-Design Product: Refer to Schedule.
 - 6. Structural Classification:
 - a. Intermediate-duty or Heavy-duty system.
- C. Metal Edge Moldings and Trim:
- 1. Basis-of-Design Product: Match Existing (E) moldings and trim.
 - 2. Roll-Formed, Sheet-Metal Edge Moldings and Trim:
 - a. Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - b. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 - c. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 - d. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 - 3. Extruded-Aluminum Edge Moldings and Trim:

- a. Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
 - b. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
- D. Custom Perimeter Trim:
1. Tegal Ceiling Locations: 4 inch high, Knife Edge.
 2. Extruded-Aluminum Edge Moldings and Trim:
 - a. Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with the following:
 - 1) Baked-Enamel or Powder-Coat Finish:
 - a) Minimum dry film thickness of 1.5 mils (0.04 mm).
 - b) Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 2) Reinforcing "strong-back" for metal suspension system to allow suspension system hanger to be recessed a minimum of 24 inches back from the custom perimeter trim.
- E. Acoustical Sealant:
1. Products: Subject to compliance with requirements, provide one of the following:
 2. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation "AC-20 FTR Acoustical and Insulation Sealant"
 - b. Specified Technologies, Inc. "SpecSeal Elastomeric Sealant"
 - c. USG Corporation "SHEETROCK Acoustical Sealant"

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
1. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

3.2 FIELD QUALITY CONTROL

- A. Field Test: Testing laboratory, engaged at the Owner's expense, will perform the following activities at the Owner's discretion. Work not meeting specified requirements and other units having similar deficiencies shall be corrected at no cost to the Owner.
1. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
 - a. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - 1) Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
 - 2) When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
 2. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
 3. Prepare test and inspection reports.
- B. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Seismic design compliance.

3.3 CLEANING

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

3.2 CEILING TYPE SCHEDULES

A. Panel Schedule: Match Existing (E)

1. TYPE ACT-I

- a. Manufacturer: ARMSTRONG WORLD INDUSTRIES
- b. Design: "Cirrus, Beveled Tegular Panel, Fine Texture"
- c. Material: Mineral fiber panel with clear sealant membrane.
- d. Size: 24" x 24" x 3/4" panel – Beveled Tegular y-in edge.
- e. Mounting: Suprafine XL 9/16" Exposed Tee System, White

- f. NRC
Rating: Not
less than .75
- g. CAC Range:
35
- h. Light Reflectance per ASTM E1477 "Test method for
Luminous Reflectance Factor of Acoustical Materials by
Use of Integrating-Sphere Reflectometers":
1) 0.90.
- i. ASTM Classification per ASTM E1264 "Classification for
Acoustical Ceiling Products":
1) Type IV, Form 2, Pattern E,
Class A per ASTM E84, "Test method for Surface
burning Characteristics of Building Materials"
2) Flame Spread Index 25 or under.
3) Smoke Density Developed Index 50 or less.
- j. Color: White

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SECTION 09 6513

RESILIENT BASE AND ACCESSORIES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient Base
 - 2. Resilient Molding Accessories

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section “Project Meetings”, with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Schedules: Schedule of units, using same room designations shown on drawings.
- C. Samples:
 - 1. Initial Selection: Furnish manufacturer’s complete color selection showing full range of colors and finish characteristics. Furnish the following.
 - a. For each type of product indicated.
 - 2. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. 12 inch (304.8 mm) long, of each resilient product color, texture, and pattern required.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
 - 1. Refer to Division 01 Section “LEED Requirements” for requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following.

1. Maintenance Data:
 - a. Maintenance Manual: Assemble into binder.
 - 1) Maintenance Practices: Manufacturer's recommended maintenance practices describing the materials, devices and procedures to be followed in cleaning and maintaining the Work.
 - 2) Operating Instructions: Manufacturer's recommended operating instructions describing the procedures to be followed in operating the Work. Include manufacturer's brochures and lists describing the actual materials used in the Work.
2. Record documents.

B. Sustainable Design Closeout Documentation

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Submit the following to the Owner.
 1. Extra Stock Material: Furnish for each size, pattern and color installed in the Work. Deliver in manufacturer's original packaging and store at the project site where directed by the Owner. Furnish and deliver the following:
 - a. Furnish not less than 100 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed. Provide full boxes of labeled product.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations authorities having jurisdiction. Obtain necessary approvals from all such authorities.
- B. Qualifications:
 1. Contractor: Contractor is responsible for quality control of the Work.
 2. Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.
 3. Installer: An installer trained in the use of the materials and equipment to be employed in the Work.
- C. Mockups:
 1. General:
 - a. Provide resilient products with mockups specified in other Sections.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and Acceptance Requirements: Deliver materials in manufacturer's original packaging with label indicating pertinent information identifying the item.
- B. Storage and Handling Requirements: Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.
 - 1. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.8 PROJECT CONDITIONS

- a. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during 48 hours before installation, during installation, and 48 hours after installation.
- b. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

PART 2 – PRODUCTS

2.1 PERFORMANCE

- A. Performance Requirements:
 - 1. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 MATERIALS

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, provide the following:
 - a. Basis of Design: Subject to compliance with requirements, provide the following:
 - a. BURKE FLOORING.
 - b. Acceptable alternative manufacturers:
 - 1) MANNINGTON COMMERCIAL.
 - 2) ROPPE CORPORATION.
 - 2. Resilient Base Standard: ASTM F 1861.
 - a. Rubber:

- 1) Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
 - 2) Manufacturing Method: Group I (solid, homogeneous).
 - b. Vinyl:
 - 1) Material Requirement: Polyvinyl chloride (PVC), Group 1 (solid), Type TV.
 - 2) Manufacturing Method: Group I (solid, homogeneous).
 - c. Style:
 - 1) Carpet locations: Straight (flat or toeless).
 - 2) All other locations: Cove (base with toe).
 3. Minimum Thickness:
 - a. 0.125 inch (3.2mm).
 4. Height:
 - a. Base height shall be 6", or match (E) adjacent height.
 5. Lengths:
 - a. Coils in manufacturer's standard length.
 6. Outside Corners:
 - a. Preformed.
 7. Inside Corners:
 - a. Preformed.
 8. Finish:
 - a. As selected by Architect from manufacturer's full range.
 9. Colors and Patterns:
 - a. Match existing (E)
- B. Resilient Molding Accessory:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. As indicated in drawings.
 2. Description:
 - a. Carpet edge for glue-down applications.
 - b. Nosing for resilient floor covering
 - c. Reducer strip for resilient floor covering
 - d. Joiner for tile and carpet
 - e. Transition strips, reducer strips, joiner strips and floor finish edges as indicated.
 3. Material:
 - a. Rubber.
 4. Profile and Dimensions:
 - a. As indicated and as required to comply with the applicable accessibility requirements.
 5. Colors and Patterns:
 - a. Match existing (E), or
 - b. As indicated, if not indicated, as selected by Architect from full range of industry colors.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- a. Comply with manufacturer's written instructions for installing resilient base.
- b. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- c. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- d. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- e. Do not stretch resilient base during installation.
- f. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- g. Preformed Corners: Install preformed corners before installing straight pieces.
- h. Job-Formed Corners:
 - 1) Inside Corners: Use straight pieces of maximum lengths possible.
 - a) Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- a. Comply with manufacturer's written instructions for installing resilient accessories.
- b. Resilient Stair Accessories:
 - 1) Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2) Tightly adhere to substrates throughout length of each piece.
- c. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Per form the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. At the end of each work day, remove unused materials, debris and containers from the site.
- D. Construction Waste Management:
 - 1. At the end of each work day, recycle or dispose of unused material, debris and containers in accordance with Division 01 Section "Construction Waste Management and Disposal."
- E. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

END OF SECTION

SECTION 09 6519
RESILIENT TILE FLOORING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Luxury Vinyl Floor Tile

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Shop Drawings: Show fabrication and installation of the Work. Include the following.
1. Floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 2. Show details of special patterns.
- C. Schedules: Schedule of units, using same room designations shown on drawings.
- D. Samples:
1. Initial Selection: Furnish manufacturer's complete color selection showing full range of colors and finish characteristics.
 2. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Full-size units of each color and pattern of floor tile required.
 - b. Seam running lengthwise and in center of 6 by 9 inch (152.4 by 228.6 mm) Sample applied to a rigid backing and prepared by Installer for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following.
 - 1. Maintenance Data:
 - a. Maintenance and Operating Manual: Assemble into binder.
 - 1) Maintenance Practices: Manufacturer's recommended maintenance practices describing the materials, devices and procedures to be followed in cleaning and maintaining the Work.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Submit the following to the Owner.
 - 1. Extra Stock Material: Furnish for each size, pattern and color installed in the Work. Deliver in manufacturer's original packaging and store at the project site where directed by the Owner. Furnish and deliver the following:
 - a. Tile: Furnish not less than one box for each 50 boxes or fraction thereof, for each type, color, pattern and size installed.

PART 2 – PRODUCTS

2.1 PERFORMANCE

- A. Design Criteria:
 - 1. Walking Surfaces: Minimum static coefficient of friction of 0.80 at ramps and 0.60 at floors and stairs, wet and dry, as tested in accordance with ASTM D 2047 and in compliance with A.D.A slip resistance recommendations for accessible routes.
- B. Performance Requirements:
 - 1. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 MATERIALS

- A. Luxury Vinyl Floor Tile:
 - 1. Tile Standard: Comply with ASTM F 1700.
 - 2. Products: Subject to compliance with requirements, provide the products listed on the drawings.
 - 3. Size: As indicated on the drawings.
 - 4. Colors and Patterns: As indicated on the drawings. If not indicated, as selected by Architect from full range of industry colors.
- B. Miscellaneous:
 - 1. Concrete Substrate:

- a. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
 - b. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
2. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.

- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish. Apply two coat(s).
- C. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 09 6813

TILE CARPETING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Modular Carpet Tile

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site and related Work.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Shop Drawings: Show fabrication and installation of the Work. Include the following.
1. Type of installation.
 2. Type, color, and location of edge, transition, and other accessory strips.
 3. Transition details to other flooring materials.
 4. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 5. Type of subfloor.
 6. Pattern of installation.
 7. Pattern type, location, and direction.
 8. Pile direction.
- C. Schedules: Schedule of units, using same room designations shown on drawings.
- D. Samples:
1. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Carpet Tile: Full-size Sample.
 - b. Exposed Edge, Transition, and Other Accessory Stripping: 12 inch (308.4 mm) long Samples.

1.4 INFORMATIONAL SUBMITTALS

A. Sustainability Submittals:

1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.5 CLOSEOUT SUBMITTALS

A. Submit the following.

1. Maintenance Data:

- a. Maintenance Manual: Assemble into binder.

- 1) Maintenance Practices: Manufacturer's recommended maintenance practices describing the materials, devices and procedures to be followed in cleaning and maintaining the Work.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Submit the following to the Owner.

1. Extra Stock Material: Furnish for each size, pattern and color installed in the Work. Deliver in manufacturer's original packaging and store at the project site where directed by the Owner. Furnish and deliver the following:

- a. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m). Provide material in original boxes, plastic wrapped and labeled with material and installation location. Provide full boxes.

PART 2 – PRODUCTS

2.1 PERFORMANCE

A. Performance Requirements:

1. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.
2. Carpet pile height a maximum of 1/2 inch (12.7 mm) in compliance with California Building Code 2019 Division 3 section 11B-302.2.

2.2 MATERIALS

A. Carpet Tile:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
2. Color: Match Architect's samples.
3. Pattern: Match Architect's samples.
4. Primary Backing/Backcoating: Manufacturer's standard composite materials unless noted otherwise.

5. Secondary Backing: Manufacturer's standard material unless noted otherwise.
 6. Size: As indicated in the drawings.
 7. Applied Soil-Resistance Treatment: Manufacturer's standard material.
 8. Antimicrobial Treatment: Manufacturer's standard material.
 9. Performance Characteristics:
 - a. Minimum Appearance Retention Rating:
 - 1) Moderate traffic, 2.5 minimum according to ASTM D 7330.
 - b. Critical Radiant Flux Classification:
 - 1) Not less than 0.25 W/sq. cm.
 - c. Dry Breaking Strength:
 - 1) Not less than 100 lbf (445 N) according to ASTM D 2646.
 - d. Tuft Bind:
 - 1) Cut Pile: Not less than 5 lbf (22 N) according to ASTM D 1335.
 - 2) Loop Pile: Not less than 10 lbf (45 N) according to ASTM D 1335.
 - e. Delamination:
 - 1) Not less than 3.5 lbf/in. (15 N/mm) according to ASTM D 3936.
 - f. Dimensional Tolerance:
 - 1) Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
 - g. Dimensional Stability:
 - 1) 0.2 percent or less according to ISO 2551 (Aachen Test).
 - h. Resistance to Insects for wool carpets:
 - 1) Comply with AATCC 24.
 - i. Colorfastness to Crocking:
 - 1) Not less than 4, wet and dry, according to AATCC 165.
 - j. Colorfastness to Light:
 - 1) Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
 - k. Antimicrobial Activity:
 - 1) Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
 - l. Electrostatic Propensity:
 - 1) Less than 3.5 kV according to AATCC 134.
- B. Miscellaneous:
1. Trowelable Leveling and Patching Compounds:
 - a. Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
 2. Adhesives:
 - a. Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 3. Concrete Floor Primer:
 - a. Provide primer to reduce the moisture emission of the concrete slabs to an amount to allow installation of the floor finish and adhesive as indicated and as required by contractors schedule constraints.
 - b. Provide BASF, Chemrex Concrete Floor Primer, subject to approval by flooring manufacturer.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
 - 1. Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710.
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- D. Preparation: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- E. Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- F. Installation Method: As recommended in writing by carpet tile manufacturer.
- G. Maintain dye lot integrity. Do not mix dye lots in same area.
- H. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- I. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- J. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- K. Install pattern parallel to walls and borders.
- L. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.

2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

END OF SECTION

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SECTION 09 7714

ACOUSTICAL FABRIC WALL SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Acoustical Fabric Wall System

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section “Project Meetings”, with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work. Include the following.
 - 1. Data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.
- B. Shop Drawings: Show fabrication and installation of the Work.
- C. Samples:
 - 1. Initial Selection: Furnish manufacturer’s complete color selection showing full range of colors and finish characteristics. Furnish the following.
 - a. Material as requested by Architect.
 - 2. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Fabric Wrapping Track System: 12 inch (304.8 mm) long of each type.
 - b. Core Material: 12 inch (304.8 mm) square.
 - c. Fabric: 12 inch (304.8 mm) square of each type, color and pattern.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
 - 1. Refer to Division 01 Section “LEED Requirements” for requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following.
 - 1. Maintenance Data:
 - a. Maintenance Manual: Assemble into binder.
 - 1) Maintenance Practices: Manufacturer's recommended maintenance practices describing the materials, devices and procedures to be followed in cleaning and maintaining the Work.

1.6 MAINTENANCE MATERIAL SUBMITTALS:

- A. Submit the following to the Owner.
 - 1. Extra Stock Material: Furnish for each size, pattern and color installed in the Work. Deliver in manufacturer's original packaging and store at the project site where directed by the Owner. Furnish and deliver the following:
 - a. Fabric: 10 percent of amount installed but no fewer than 10 yards (9m).

PART 2 – PRODUCTS

2.1 PERFORMANCE

- A. Design Criteria:
 - 1. Design, engineer, fabricate, and install work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
- B. Fire Performance Characteristics: Provide acoustical ceiling components that are identical to those tested for the following fire performance characteristics, according to ASTM test method indicated, by UL or other testing and inspecting agency. Identify acoustical ceiling components with appropriate marking of applicable testing and inspecting agency.
 - 1. Surface Burning Characteristics: ASTM E 84.
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.

2.2 FABRICATION

- A. Fabric Wrapping Track System:
 - 1. As selected by Architect from manufacturer's full line.
 - 2. Color: As selected by Architect from manufacturer's full line.
 - 3. Extruded Aluminum Angle: Size to accommodate acoustical core and attachment of track.
 - 4. Basis-of-Design Product:
 - a. Subject to compliance with requirements, the design is based on the following manufacturer's product.
 - 1) FabriTrak Systems, Inc. "2" FabriTrak Profiles"

B. Acoustical Core.

1. Fiberglass Board:
 - a. Thickness: 2"

C. Acoustical Textile Covering:

1. Basis-of-Design Product:
 - a. Subject to compliance with requirements, the design is based on the following manufacturer's product.
 - 1) FTS Fabrics

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Fabric Wrapping Track System:
 1. Field measure each area to receive system.
 2. Secure system to substrate with method that is approved by tracking manufacturer.
 3. Install system plumb and straight, flush in proper alignment.
- C. Core Material:
 1. Install in a continuous manner, flush and level with track framing.
 2. Install tight to the track framing at all points
- D. Fabric:
 1. Cut fabric from each roll marking and maintaining sequence drops and matching direction weave for sequential and uniform installation.
 2. Install fabric from the face side to wrapping track system.
 3. Stretch fabric tautly evenly and smoothly to achieve work free of defects and flaws.

3.2 CLEANING

- A. Fabric: Clean exposed surfaces. Trim and remove loose threads.
- B. Construction Waste Management:
 1. At the end of each work day, recycle or dispose of unused material, debris and containers in accordance with Division 01 Section "Construction Waste Management and Disposal."

END OF SECTION

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SECTION 09 8100
ACOUSTIC INSULATION

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Acoustical Board Insulation:
 - 2. Pipe Lagging
 - 3. Pipe Wrap

- B. Related Sections: Requirements that relate to this section are included but not limited to the section below.
 - 1. Division 03 Section “Cast-In-Place Concrete” for concrete requirements.
 - 2. Division 22 “Plumbing” for piping requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section “Project Meetings”, with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site and related Work.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.

- B. Shop Drawings: Show fabrication and installation of the Work.

- C. Samples:
 - 1. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. 6 inch (152.4 mm) square in range of finish selected.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
 - 1. Refer to Division 01 Section “LEED Requirements” for requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following.
 - 1. Record documents.
 - 2. Sustainable Design Closeout Documentation

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations authorities having jurisdiction. Obtain necessary approvals from all such authorities.
- B. Qualifications:
 - 1. Contractor: Contractor is responsible for quality control of the Work.
 - 2. Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.
 - 3. Installer: An installer trained in the use of the materials and equipment to be employed in the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and Acceptance Requirements: Deliver materials in manufacturer's original packaging with label indicating pertinent information identifying the item.
- B. Storage and Handling Requirements: Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.

PART 2 – PRODUCTS

2.1 PERFORMANCE

- A. Design Criteria:
 - 1. General:
 - a. Provide work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
 - b. Regulations: Conform with the requirements of the applicable Building Code as it pertains to engineering, design, fabrication and installation of system.
 - 2. Fire performance:
 - a. Non-combustibility: To ASTM E136.
 - b. Surface Burning Characteristics: To ASTM E84.
 - 1) Flame spread unfaced: 5.
 - 2) Smoke developed unfaced: 5.

2.2 MATERIALS – GENERAL

- A. Single Source Responsibility:
 - 1. Obtain materials from a single manufacturer for each different product required.
- B. Sustainable Requirements:
 - 1. Provide materials to comply with the requirements of Division 01 Section "Sustainability Requirements".

2.3 FABRICATION

- A. Glass-Fiber Blanket Insulation
 - 1. Unfaced Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
 - 2. Basis of Design Product:
 - a. Subject to compliance with requirements, provide products by one of the following:
 - 1) CertainTeed Corporation
 - 2) Guardian Fiberglass, Inc.
 - 3) Owens-Corning, or equal
- B. Acoustical Board Insulation:
 - 1. Non-combustible, semi-rigid, mineral wool fire rated insulation board to ASTM C612, Type IVA
 - a. Thermal resistance R value/1 inch at 75 °F: 4.2 h ft² °F/Btu to ASTM C518.
 - b. Water Vapor Permeance:
 - 1) Unfaced: 30 Perm maximum.
 - c. Moisture Absorption: 1 % to ASTM C1104/C1104M.
 - d. Dimensional Stability: 1 % maximum linear shrinkage at 1200 °F to ASTM C356.
 - e. Fungi Resistance: Passed to ASTM C1338.
 - f. Corrosive Resistance:
 - 1) Steel to ASTM C665: Pass.
 - 2) Stainless Steel to ASTM C795: Conforms.
 - 2. Compressive resistance:
 - a. At 10 %: 90 psf to ASTM C165.
 - b. At 25 %: 226 psf to ASTM C165.
 - 3. Size: 24 x 48 inches.
 - 4. Thickness: As required to meet acoustical requirement.
 - 5. Basis-of-Design Product:
 - a. Subject to compliance with requirements, the design is based on the following manufacturer's product.
 - 1) Roxul "RockBoard"
- C. Pipe Lagging:
 - 1. 2 inch fiberglass surrounded by 1 psf mass loaded vinyl.
 - 2. Flammability:

- a. Flame Spread Index less than 12.6
 - b. Smoke Density less than 19.6
 3. Acoustical:
 - a. Pie and duct lagging with a STC value of at least 29.
 4. Basis-of-Design Product:
 - a. Subject to compliance with requirements, the design is based on the following manufacturer's product.
 - 1) Sound Seal "B-10 / QFA-9"
- D. Pipe Wrap:
1. 2 inch thick fiberglass batt.
 2. Flammability:
 - a. Flame Spread Index: 10
 - b. Smoke Developed Index: 40
 3. Basis-of-Design Product:
 - a. Subject to compliance with requirements, the design is based on the following manufacturer's product.
 - 1) Kinetics "KNM-100"

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine and correct conditions of area to receive the Work prior to installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Acoustical Board Insulation:
 1. Install insulation board using mechanical fasteners in accordance with insulation manufacturer's written recommendations.
 2. Attach insulation board with 1-1/2 inches concrete nails and seal with bitumen sealing compound.
 3. Seal joints with acoustical joint sealant in accordance with Division 07 Section "Joint Sealants".
- C. Pipe Lagging:
 1. Treat PVC storm piping at the offset above first floor rooms extending 5 ft upstream and downstream.
 2. Lag the PVC pipe with 2 inch fiberglass surrounded by 1 psf mass loaded vinyl.

D. Pipe Wrap:

1. Alternately, wrap the pipe with 2 inch thick fiberglass batt.
2. Surround the fiberglass with 1 psf mass loaded vinyl.
3. Compress the insulation slightly and overlap the edges

3.3 CLEANING

- A. At the end of each work day, remove unused materials, debris and containers from the site.
- B. Construction Waste Management:
 1. At the end of each work day, recycle or dispose of unused material, debris and containers in accordance with Division 01 Section "Construction Waste Management and Disposal."

3.4 PROTECTION

- A. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

END OF SECTION

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SECTION 09 9123
INTERIOR PAINTING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surface preparation and the application of paint systems on interior substrates.
 - a. Metal Materials:
 - 1) Ferrous Metals
 - 2) Zinc-Coated Metals
 - b. Gypsum board.
 - 1) Paper Faced Gypsum
 - 2) Fiberglass Faced Gypsum
 - c. Wood
 - d. Exposed Overhead Work

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 REFERENCES

A. Definitions:

1. Gloss Levels:
 - a. Gloss Level 1 (flat): Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
 - b. Gloss Level 2 (velvetine): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
 - c. Gloss Level 3 (eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
 - d. Gloss Level 4 (satin): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
 - e. Gloss Level 5 (semigloss): 35 to 70 units at 60 degrees, according to ASTM D 523.
 - f. Gloss Level 6 (gloss): 70 to 85 units at 60 degrees, according to ASTM D 523.
 - g. Gloss Level 7 (high gloss): More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Schedules: Schedule of units, using same room designations shown on drawings.
 - 1. Cross-reference to paint system and locations of application areas.
- C. Samples:
 - 1. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Submit Samples on rigid backing, 8 inch (203.2 mm) square.
 - b. Step coats on Samples to show each coat required for system.
 - c. Label each coat of each Sample.
 - d. Label each Sample for location and application area.
 - e. Provide three samples of each color and finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
 - 1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Submit the following to the Owner.
 - 1. Extra Stock Material: Furnish for each size, pattern and color installed in the Work. Deliver in manufacturer's original packaging and store at the project site where directed by the Owner. Furnish and deliver the following:
 - a. Paint: 3 percent, but not less than 1 gal. (3.8 L) of each material and color applied. Product to be supplied in original gallon containers labeled with product information and installation location.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Sherwin-Williams Company (The)
 - 2. Dunn-Edwards Paints
 - 3. Frazee Paints
 - 4. Benjamin Moore & Co.
 - 5. PPG Paints

2.2 MATERIALS – GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content of Field-Applied Interior Paints and Coatings: Products shall comply with VOC limits of authorities having jurisdiction and to the following limits for VOC content, these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - 1. Provide materials to comply with the requirements of Division 01 Section "LEED Requirements".
- D. Colors: As indicated on Architect's drawings.

2.3 MATERIALS

- A. Block Fillers:
 - 1. Block Filler, Latex, Interior/Exterior: MPI #4.
 - a. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25 (E3)
 - b. Benjamin Moore; Super spec 206/K206 (E3)
 - c. PPG Paints; 6-15 Speedhide Interior/Exterior Masonry Hi – Fill Block filler (E3)
- B. Primer / Sealers:
 - 1. Primer Sealer, Latex, Interior: MPI #50.
 - a. Sherwin-Williams; ProGreen 200 Interior Latex Primer B28W00600 (E3).
 - b. Benjamin Moore; Ultra Spec 500 N534 (E3).
 - c. PPG Paints; Speedhide Zero VOC Interior Primer 6-4900XI (E3).
 - 2. Primer, Latex, for Interior Wood: MPI #39 or as noted.
 - a. Sherwin-Williams; PrepRite ProBlock Int/Ext Latex Primer Sealer B51W20 (E2).
 - b. Benjamin Moore; Ultra Spec 500 N534 (E3)
 - c. PPG Paints; Seal Grip Int/Ext Stain Blocking Primer 17-921 (E2).
- C. Metal Primers:
 - 1. Primer, Rust-Inhibitive, Water Based: MPI #107.
 - a. Sherwin-Williams; Pro Industrial Pro-Cryl Universal Primer B66W310 (E3).
 - b. Benjamin Moore; Super Spec High Performance; P04/KP04 (E3).
 - c. PPG Paints; Pitt-Tec Plush Int/Ext DTM Industrial Primer 90-912 Series (E3).
 - 2. Primer, Galvanized, Water Based: MPI #134.
 - a. Sherwin-Williams; Pro Industrial Pro-Cryl Universal Primer B66W310 (E3).
 - b. Benjamin Moore; Super Spec High Performance Acrylic Metal Primer; P04/KP04 (E3).
 - c. PPG Paints; Pitt-Tec Plush Int/Ext DTM Industrial Primer 90-912 Series (E3).

D. Water Based Paints:

1. Latex, Interior, Flat, (Gloss Level 1): MPI #53.
 - a. Sherwin-Williams; ProMar 200 Zero VOC Interior Latex Flat B30W2651 (E3)
 - b. Benjamin Moore; Ultra Spec 500, N536 (E3)
 - c. PPG Paints; Speedhide Zero VOC Interior Latex Flat 6-4110XI (E3).
2. Latex, Interior, (Gloss Level 2): MPI #44.
 - a. Sherwin-Williams; ProMar 200 Zero VOC Interior Latex EgShel B20W2651 (E3)
 - b. Benjamin Moore; Ultra Spec 500, N537 (E3)
 - c. PPG Paints; Speedhide Zero Interior Eggshell 6-4310XI Series (E3)
3. Latex, Interior, (Gloss Level 3): MPI #52.
 - a. Sherwin-Williams; ProMar 200 Zero VOC Interior Latex EgShel B20W2651 (E3)
 - b. Benjamin Moore; Ultra Spec 500, N538 (E3)
 - c. PPG Paints; Speedhide Zero Interior Satin Latex 6-4410XI Series (E3)
4. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.
 - a. Sherwin-Williams; ProMar 200 Zero VOC Interior Latex Semi-Gloss B31W2651 (E3)
 - b. Benjamin Moore; Ultra Spec 500, N540 (E3)
 - c. PPG Paints; Speedhide Zero Interior Latex Semi-Gloss 6-4510XI Series (E3)
5. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5): MPI #141.
 - a. Sherwin-Williams; Pro Industrial Zero VOC Acrylic Semi-Gloss B66W00651 (E3)
 - b. Benjamin Moore; Ultra Spec 500, N540 (E3)
 - c. PPG Paints; Manor Hall Semi-Gloss 82-500 (E3)
6. Water Based Alkyd, Semi-Gloss (Gloss Level 5): MPI #169 and as listed below.
 - a. Sherwin-Williams; ProMar 200 WB Alkyd-Acrylic Semi-Gloss, B34W8251 (VOC<100 g/L)
 - b. Benjamin Moore; Advance 793.
 - c. PPG Paints; Speedhide; 6-1410 (VOC <50 g/L)
7. Acrylic, Flat, Dry Fall for Exposed Overhead Work:
 - a. Sherwin-Williams; Waterborne Acrylic Dryfall
 - b. Benjamin Moore; IMC Sweep-Up Spray Latex Flat.
 - c. PPG Paints; Speedhide Super Tech WB Interior Dry Fog Latex Flat 6-725XI

E. Epoxy Coatings;

1. Epoxy-Modified Latex, Interior, Gloss (Gloss Level 6): MPI #115.
 - a. Sherwin-Williams; Pro Industrial Zero VOC Waterbased Catalyzed Epoxy B73 series (E3)
 - 1) Alternate: Sherwin-Williams; Industrial & Marine Water Based Catalyzed Epoxy B70 Series (E2)
 - b. Benjamin Moore; Super Spec HP Waterborne Polyamid Epoxy Gloss P42 (E2) (VOC<200 g/L)
 - c. PPG Paints Amerlock 2 VOC Epoxy (VOC 84 g/L) (not MPI)
 - d. Primer: As recommended by epoxy paint manufacturer for substrate and compliant with VOC requirements.

2.4 PAINTS

- A. As indicated in the painting schedule and as indicated in the drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

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

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
 - 5. Plaster: 12 percent.

- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms and where exposed in occupied spaces:

- a. Equipment, including panelboards and switch gear except items that are prefinished.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Tanks that do not have factory-applied final finishes.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.6 INTERIOR PAINTING SCHEDULE

1. High-Performance Architectural Latex System:
 - a. Locations: As noted.
 - b. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - d. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5), MPI #141.
 2. Epoxy-Modified Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6), MPI #115.
 - c. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6), MPI #115.
- B. Steel Substrates:
1. Exposed Overhead Steel Framing:
 - a. Latex over Acrylic Primer System:
 - 1) Locations: Overhead Steel Framing
 - 2) Prime Coat: Shop primer specified in Section where substrate is specified or as recommended by the topcoat paint manufacturer or rust-inhibitive, waterbased MPI #107.
 - 3) Intermediate Coat: Latex, interior, matching topcoat.
 - 4) Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
 - 5) Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
 2. Doors, door frames, guardrails, handrails and decorative trim: Water Based Alkyd System:
 - a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
 - b. Intermediate Coat: Water Based Alkyd, matching topcoat.
 - c. Topcoat: Water Based Alkyd, semi-gloss (Gloss Level 5), MPI #169 or as listed.
 3. Exposed Overhead Work:
 - a. Primer: Acrylic, Flat, Dry Fall
 - b. Topcoat: Acrylic, Flat, Dry Fall
- C. Galvanized-Metal Substrates:
1. Latex over Waterborne Primer System:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
- D. Wood Substrates: Including wood trim, architectural woodwork doors, and wood-based panel products.
1. Latex System:
 - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
- E. Gypsum Board and Plaster Substrates:
1. Latex System:
 - a. Locations: Typical on gypsum board and plaster unless noted otherwise.
 - b. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - d. Topcoat at Ceilings: Latex, interior, flat, (Gloss Level 1), MPI #53.
 - e. Topcoat at Walls:
 - 1) Latex, Interior, (Gloss Level 2), MPI #44.
 - 2) Latex, interior, (Gloss Level 3), MPI #52.

END OF SECTION

SECTION 10 1000
VISUAL DISPLAY SURFACES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Magnetic Porcelain Enamel Markerboard:
 - a. Fixed Units

B. Related Sections: Requirements that relate to this section are included but not limited to the section below.

1. Division 06 Section “Miscellaneous Rough Carpentry” for wood blocking and grounds.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section “Project Meetings”, with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site and related Work.

1.3 ACTION SUBMITTALS

A. Product Data: Describe the properties of items to be used in the Work.

B. Shop Drawings: Show fabrication and installation of the Work. Include the following.

1. Markerboard: Sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

C. Samples:

1. Initial Selection: Furnish manufacturer’s complete color selection showing full range of colors and finish characteristics.
2. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.

- a. Markerboards: 8-1/2 inch by 11 inch (215.9 mm) for each type each color, texture, and pattern required.
- b. Extrusions: 12 inch (304.8 mm) long of each finish selected.

1.4 INFORMATIONAL SUBMITTALS

A. Sustainability Submittals:

1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.5 CLOSEOUT SUBMITTALS

A. Submit the following.

1. Operation and Maintenance Data:

- a. Operating Manual:

- 1) Operating Instructions: Manufacturer's recommended operating instructions describing the procedures to be followed in operating the Work. Include manufacturer's brochures and lists describing the actual materials used in the Work.

2. Record documents.

3. Sustainable Design Closeout Documentation

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations authorities having jurisdiction. Obtain necessary approvals from all such authorities.

B. Qualifications:

1. Contractor: Contractor is responsible for quality control of the Work.

2. Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.

3. Installer: An installer trained in the use of the materials and equipment to be employed in the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and Acceptance Requirements: Deliver materials in manufacturer's original packaging with label indicating pertinent information identifying the item.

- B. Storage and Handling Requirements: Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.

1.8 PROJECT CONDITIONS

- A. Ambient Conditions: Proceed with the Work in accordance with manufacturer's requirements and instructions and any agreements or restrictions of the Pre-Construction Conference.
- B. Project Conditions: Field measure at location of the Work prior to preparation of the shop drawings. Include measurements of adjacent construction to which the Work must fit. Coordinate construction to ensure that actual opening dimensions correspond to fabricated dimensions of the Work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

PART 2 – PRODUCTS

2.1 DESCRIPTION

- A. Design Requirements:
 - 1. Provide work in compliance with specified standards, performance requirements, material selections, and requirements of this and related sections.
- B. Performance Requirements:
 - 1. Fire Performance Characteristics: Surface burning characteristics indicated below, as determined by testing assembled materials composed of facings and backings identical to those required in this section, in accordance with ASTM E 84, by a testing organization acceptable to authorities having jurisdiction.
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 10 or less.

2.2 MATERIALS – GENERAL

- A. Single Source Responsibility:
 - 1. Obtain materials from a single manufacturer for each different product required.
- B. Sustainable Requirements:
 - 1. Provide materials to comply with the requirements of Division 01 Section "Sustainability Requirements".

2.3 FABRICATION

A. Magnetic Porcelain Enamel Markerboards:

1. Assembly: Provide factory-assembled units, except where field-assembled units are required.
 - a. Make joints only where total length exceeds maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Architect [Engineer].
 - b. Provide the manufacturer's standard vertical joint system between abutting sections of board.
 - c. Provide manufacturer's standard mullion trim at joints between boards.
2. Markerboard: Provide balanced, high-pressure-laminated porcelain enamel boards of 3-ply construction consisting of face sheet, core material, and backing.
 - a. Face Sheet: Provide face sheet of 24 gage (0.607 mm) enameling grade steel especially processed for temperatures used in coating porcelain on steel. Coat the exposed face and exposed edges with a 3-coat process consisting of primer, ground coat, and color cover coat, and the concealed face with a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at the manufacturer's standard firing temperatures, but not less than 1200 deg F (649 deg C).
 - 1) Cover Coat: Provide the manufacturer's standard light-colored special writing surface with gloss finish intended for use with liquid felt-tipped markers.
 - b. Core: Provide the manufacturer's standard 3/8 inch (9.525 mm) [9 mm] thick particleboard core material complying with the requirements of ANSI A 208.1, Grade 1-M-1.
 - c. Backing Sheet: Provide the manufacturer's standard 0.015 inch (0.38 mm) thick aluminum sheet.
 - d. Laminating Adhesive: Provide the manufacturer's standard moisture-resistant thermoplastic-type adhesive.
 - e. Color: As selected by Architect from manufacturer's full line.
3. Trim Finish: Clear anodized aluminum.
4. Fixed Units:
 - a. Basis-of-Design Product:
 - 1) Subject to compliance with requirements, the following manufacturer's product will be considered as equal.
 - a) Steelcase Polyvision "Markerboard e³, 500 Series Trim"
 - b) Claridge Products and Equipment, Inc. "24 Gauge LCS, Series 4 Trim"
 - c) Mooreco Inc. "Dura-Rite Whiteboard with Deluxe Aluminum Trim"
5. Miscellaneous:

a. Hardware:

- 1) Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; slim size and standard shape.
 - a) Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect .
 - b) Marker Tray: Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.
- 2) Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- 3) Aluminum Finish:
 - (1) Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine and correct conditions of area to receive the Work prior to installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.

3.3 CLEANING

- A. At the end of each work day, remove unused materials, debris and containers from the site.
- B. Construction Waste Management:
 1. At the end of each work day, recycle or dispose of unused material, debris and containers in accordance with Division 01 Section "Construction Waste Management and Disposal."

3.4 PROTECTION

- A. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

END OF SECTION

SECTION 10 1100
TACKABLE SURFACES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tackable Surface;

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site and related Work.

1.4 ACTION SUBMITTALS

A. Product Data: Describe the properties of items to be used in the Work.

B. Shop Drawings: Show fabrication and installation of the Work. Include the following.

1. Plans, elevations, sections, details, and attachments to other work.
2. Show locations of panel joints.
3. Include sections of typical trim members.

1.5 ACTION SUBMITTALS

A. Samples:

1. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.

1. Tack Surface: 8-1/2 inch by 11 inch for each type each color, texture, and pattern required.

1.6 INFORMATIONAL SUBMITTALS

A. Sustainability Submittals:

1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.7 CLOSEOUT SUBMITTALS

A. Submit the following.

1. Record documents.
2. Sustainable Design Closeout Documentation

1.8 QUALITY ASSURANCE

- ##### A. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations authorities having jurisdiction. Obtain necessary approvals from all such authorities.

B. Qualifications:

1. Contractor: Contractor is responsible for quality control of the Work.
2. Manufacturer: A firm experienced in successfully producing work similar to that indicated for this Project, with a record of successful in-service performance, and with sufficient production capacity to produce required units without causing delay in the Work.
3. Installer: An installer trained in the use of the materials and equipment to be employed in the Work.

1.9 DELIVERY, STORAGE, AND HANDLING

- ##### A. Deliver and Acceptance Requirements: Deliver materials in manufacturer's original packaging with label indicating pertinent information identifying the item.

- ##### B. Storage and Handling Requirements: Store materials in accordance with manufacturer's instructions in a protected dry location off ground. Do not open packaging nor remove labels until time of installation.

1.10 PROJECT CONDITIONS

- A. Ambient Conditions: Proceed with the Work in accordance with manufacturer's requirements and instructions and any agreements or restrictions of the Pre-Construction Conference, including the following:
1. Manufacturer's recommendations for climatizing area for interior moisture and temperature to approximate normal occupied conditions.

PART 2 – PRODUCTS

2.1 PERFORMANCE

- A. Design Criteria:
1. Fire Performance Characteristics: Provide tackboards with surface burning characteristics indicated below, as determined by testing assembled materials composed of facings and backings identical to those required in this section, in accordance with ASTM E 84, by a testing organization acceptable to authorities having jurisdiction.
 1. Flame Spread: 25 or less.
 2. Smoke Developed: 10 or less.

2.2 MATERIALS – GENERAL

- A. Single Source Responsibility:
1. Obtain materials from a single manufacturer for each different product required.
- B. Sustainable Requirements:
1. Provide materials to comply with the requirements of Division 01 Section "Sustainability Requirements".

2.3 MATERIALS

- A. Designer Fabric: Polyester Fabric on cork underlay with 1/4" hardboard back
- B. Factory Framed Tackboards
1. Tack Surface: Designer Fabric
 2. Series 8
 3. Typical Arrangement: Type CO
 4. Panel Size: SEE DRAWINGS
 5. Panel Color: Graphite, or from manufacturer's standard colors

2.4 FABRICATION

A. Basis-of-Design Product:

1. Subject to compliance with requirements, the design is based on the following manufacturer's product.

- 1) Claridge Products – Concept Series - CP-0404-FC = 4'x4' w/
Carnegie Fabric

- ### B. Aluminum Edges: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.

2.5 FINISHES

- ### A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Aluminum:

1. Anodized Finish:

1. Trim shall be 6063 alloy grade aluminum with T5 tempering in accordance with ASTM B221, and shall have 201-R1 satin anodize finish.

- 1) Factory Built Trim - Series: 8

PART 3 – EXECUTION

3.1 EXAMINATION

- #### A. Verification of Conditions: Examine and correct conditions of area to receive the Work prior to installation.
- #### B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation:

1. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond or telegraph through to the surface of the visual display surfaces.

- #### B. Verify that interior moisture and temperature conditions match the normal occupied conditions prior to installing. Do not install on damp walls or unconditioned spaces.

3.3 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Tackable Surface
 - 1. Install in locations and at mounting heights indicated on Drawings.
 - 2. Install aluminum perimeter trim prior to the tackable surface material. Keep perimeter lines straight, level, and plumb.
 - 3. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 CLEANING

- A. Tackable Surface:
 - 1. Clean surfaces according to manufacturer's written instructions.
 - 2. Attach one cleaning label to surface in each room.
- B. At the end of each work day, remove unused materials, debris and containers from the site.
- C. Construction Waste Management:
 - 1. At the end of each work day, recycle or dispose of unused material, debris and containers in accordance with Division 01 Section "Construction Waste Management and Disposal."

3.5 PROTECTION

- A. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

END OF SECTION

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SECTION 10 1401
INTERIOR BUILDING SIGNAGE

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior Panel Signs:
 - a. Life Safety

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work.
- B. Shop Drawings: Show fabrication and installation of the Work. Include the following.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Provide colors, patterns, message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- C. Schedules: Schedule of units, using same room designations shown on drawings.
 - 1. Provide message list for each sign required, including large-scale details of wording and layout of lettering.
- D. Samples:
 - 1. Initial Selection: Furnish manufacturer's complete color selection showing full range of colors and finish characteristics. Furnish the following.
 - a. Acrylic sheet.
 - 2. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Acrylic Sheet: 8 by 10 inches (203.2 by 254 mm) for each color required.
 - b. Accessories: Manufacturer's full-size unit.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Regulatory Requirements: Comply with applicable provisions in 2010 ADA Standards for Accessible Design, state and local accessibility requirements.

PART 2 – PRODUCTS

2.1 PERFORMANCE

- A. Design Criteria:
1. General:
 - a. Regulations: Conform with the requirements of the applicable Building Code as it pertains to engineering, design, fabrication and installation of system.
 - 1) Applicable provisions in 2010 ADA Standards for Accessible Design.
 - 2) Applicable provisions in ICC/ANSI A117.1.
 - 3) Applicable provisions in the California Building Code.

2.2 MATERIALS

- A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
- B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner, complying with the following requirements:
1. Acrylic Sheet: minimum of 0.080 inch (2.03 mm) thick.
 2. Sign Design: Provide graphic services to incorporate Owner's custom design and graphics on the generic signs shown in the documents. Assume three colors on signs.
 3. Edge Condition: Square.
 4. Corner Condition: As shown in drawings, where not shown, corners to be eased to a minimum of 1/16 inch radius.
 5. Mounting: As shown by one of the methods below:
 - a. Wall mounted with two-face tape.
 - b. Manufacturer's standard anchors for substrates encountered.
 6. Custom Paint Colors: Match Pantone color matching system.
 7. Color: Match Architect's custom color sample.

- C. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed shape.

- D. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines, California Building Code 2019 11B-703 and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
 - 1. Panel Material: Manufacturer's standard
 - 2. Raised Character to comply with CBC Section 11B-703.2.
 - a. Refer to Table 11B-703.3.1 Brail Dimensions for the following:
 - 1) Depth
 - 2) Height
 - 3) Finish and Contrast
 - 4) Proportions
 - 5) Braille
 - 3. Position of Braille:
 - a. Refer to 11B-703.3.2 for location of brail on sign.
 - 4. Mounting Height and Location:
 - a. Refer to Drawings in compliance with 11B-703.4.
 - 5. Visual Characters:
 - a. Refer to Drawings in compliance with 11B-703.5.
 - 6. Pictograms:
 - a. Refer to Drawings in compliance with 11B-703.6.
 - 7. Symbol of Accessibility"
 - a. Refer to Drawings in compliance with 11B-703.7.

- E. Miscellaneous:
 - 1. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
 - 2. Adhesives: Provide adhesives and tapes as recommended by manufacturer for substrates indicated.

2.3 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
 - 1. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
 - 2. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.4 FINISHES

- A. General:

1. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 2. 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.
- B. Colored Coatings for Acrylic Sheet:
1. For copy background and frame colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

PART 3 – EXECUTION

3.1 EXAMINATION

3.2 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- C. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
- F. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
 2. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.

3. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.
- G. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION

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SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Chair rail

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.
- B. Sustainability Submittals:
 - 1. Refer to Division 01 Section "LEED Requirements" for requirements.
- C. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.
- D. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each impact-resistant plastic material, from manufacturer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Chair rail: Full-size chair rails, (5) 10 foot lengths.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

- B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Section 014000 "Quality Requirements."
- D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg. F during the period plastic materials are stored.
 - 2. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg. F.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg. F for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE

- A. Performance Requirements:
 - 1. Fire Performance Characteristics:
 - a. Components with UL label indicating that they are identical to those tested in accordance with ASTM E 84 for Class 1 characteristics listed below:

- 1) Flame Spread: 25 or less
- 2) Smoke Developed: 450 or less
2. Impact Strength:
 - a. Tested in compliance with ASTM F 476.
3. Chemical and Stain Resistance:
 - a. Tested in compliance with ASTM D 543.

2.2 MATERIALS – GENERAL

- A. Single Source Responsibility:
 1. Obtain materials from a single manufacturer for the complete system.
- B. Sustainable Requirements:
 1. Provide materials to comply with the requirements of Division 01 Section “LEED Requirements”.

2.3 MATERIALS

- A. Sheet: Polyethylene Terephthalate (PETG)
- B. Miscellaneous:
 1. Adhesives and primer as required by manufacturer.

2.4 FABRICATION

- A. Wall Covering: **WC-01**
 1. Thickness: 0.060 inch (1.52 mm).
 2. Sizes: Cut from standard sheet sizes to widths and lengths shown in the drawings.
 3. Pattern / Color: As selected by Design Professional from manufacturer’s full line of solid colors.
 4. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties “Acrovyn 4000” in standard Suede texture or comparable product by one of the following:
 - 1) Inpro Corporation.
 - 2) Or approved equal.
- B. Trim:
 1. Shapes: Standard wainscot top and bottom trim and matching inside and outside corners from manufacturer’s full line.
 2. Joints: Vertical trim option.
 3. Pattern / Color: As selected by Design Professional from manufacturer’s full line of solid colors.
 4. Options: Formed outside corner trim and vertical joint color matched caulk for pricing purposes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine walls to which impact-resistant wall protection will be attached for devices, cabinets and other wall mounted construction that will interfere with wall protection.
 - 1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 - 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.
 - 2. Install in maximum length possible. Center seam on wall where length of chair rail exceeds manufacturers maximum length.

3.4 CLEANING

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

END OF SECTION

SECTION 10 4413
FIRE EXTINGUISHER CABINETS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.
 2. Cabinet Type:
 - a. Semi-recessed Cabinets
 - b. Recessed Cabinets

1.2 ADMINISTRATIVE REQUIREMENTS

- B. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work. Include the following.
1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 2. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Schedules:
1. Product Schedule: Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.
- C. Samples:
1. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Size: 6 by 6 inch (152.4 by 152.4 mm) square.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:
 - 1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following.
 - 1. Operation and Maintenance Data:
 - a. Maintenance Manual: Assemble into binder.
 - 1) Maintenance Practices: Manufacturer's recommended maintenance practices describing the materials, devices and procedures to be followed in cleaning and maintaining the Work.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six 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. Larsen's Manufacturing Company.
 - 2. J. L. Industries, Inc., a division of Activar Construction Products Group.
 - 3. Nystrom.
 - 4. Potter Roemer LLC.

2.2 PERFORMANCE

- A. NFPA Compliance:
- B. California Compliance: Fabricate and label fire extinguishers to comply with California Code of Regulations Title 19, "Portable Fire Extinguishers."
- C. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

D. California Building Code:

1. Comply with CBC Sections 11B-307, 11B-308, 11B-309 and 11B-403.

2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304.

2.4 FABRICATION

A. Cabinets:

1. General:
 - a. Suitable for fire extinguisher.
 - b. Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1) Weld joints and grind smooth.
 - 2) Provide factory-drilled mounting holes.
 - 3) Prepare doors and frames to receive locks.
2. Cabinet Construction:
 - a. Nonrated, 1-hour fire rated, and 2-hour fire rated as required by the wall fire rating.
 - b. Fire-Rated Cabinets:
 - 1) Construct fire-rated cabinets with double walls fabricated from 0.0428 inch (1.087 mm) thick, cold-rolled steel sheet lined with minimum 5/8 inch (15.875 mm) thick, fire-barrier material. Provide factory-drilled mounting holes.
3. Cabinet Material:
 - a. Steel sheet.
 - b. Shelf: Same metal and finish as cabinet.
4. Cabinet Type:
 - a. Semi-recessed Cabinet:
 - 1) Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 2) Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - 3) Rolled-Edge Trim: 2-1/2 inch (63.5 mm) backbend depth.
 - b. Recessed Cabinet:
 - 1) Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
 - 2) One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
5. Finish:
 - a. Baked enamel finish.

B. Doors:

1. General:
 - a. Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - b. Fabricate door frames of one-piece construction with edges flanged.
 - c. Miter and weld perimeter door frames.
2. Door Material:
 - a. Steel Sheet.
 - b. Stainless Steel
3. Door Style:
 - a. Vertical duo panel with frame.
4. Door Glazing:
 - a. Manufacturer's standard.
5. Door Hardware:
 - a. Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - b. Typical Door Hardware shall include a satin finish pull handle with a self-adjusting roller latch and a continuous piano hinge.
 - 1) Vandal Resistant Hardware: Provide "Larsen-Loc" and factory applied Type A Style lettering near the handle that reads "IN CASE OF FIRE ONLY - PULL FIRMLY ON HANDLE". Provide at the locations indicated on drawings.
6. Finish:
 - a. Baked enamel finish.

C. Miscellaneous:

1. Mounting Bracket:
 - a. Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Break-Glass Strike:
 - a. Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
3. Door Lock:
 - a. Cylinder lock, keyed alike to other cabinets.
4. Identification:
 - a. Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - b. Locate as directed by Architect.
 - c. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
5. Projecting Sign Identification:
 - a. Wall mounted rigid plastic sign for installation above the fire extinguisher cabinets at locations required by the local authority having jurisdiction.

2.5 FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Ferrous Metals:

1. Baked Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
 - a. Organic Coating: Thermosetting modified acrylic enamel primer/topcoat system complying with AAMA 2603 except with minimum dry film thickness of 1.5 mils, medium gloss.
 - 1) Color: Match Architect's sample.
2. Field Painted Finish:
 - a. Shop Priming:
 - b. Preparation for Paint Finish:
 - 1) Clean surfaces of dirt, grease, and loose rust or mill scale, including items fabricated from galvanized steel, if any, followed by a conversion coating of type suited to organic coating applied over it.
 - c. Primed Finish:
 - 1) Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 2) Apply air-dried primer immediately following cleaning and pretreatment, to provide a minimum dry film thickness of 2.0 mils (0.05 mm) per applied coat, to surfaces which will be exposed after assembly and installation, and to concealed, nongalvanized surfaces.
 - d. Painted Finish:
 - 1) Comply with Division 09 Section "Interior Painting."
 - 2) Color: Match Architect's sample.

C. Stainless Steel:

1. General: Finish designations prefixed by AISI conform with the system established by the American Iron and Steel Institute for designating finishes for stainless steel sheet.
2. Mechanical Finishes:
 - a. Bright, Directional Polish: AISI No. 4 finish.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.
- B. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.

- C. Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, as required to comply with the authorities having jurisdiction and not greater than 48 inches to all operable hardware including handles for the fire extinguisher.
- D. Install fire rated fire protection cabinets in rated walls, matching the fire rating.
- E. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
- F. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- G. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged fire extinguishers.
- H. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10 4416
FIRE EXTINGUISHERS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Portable Hand-Carried Fire Extinguishers
 2. Mounting Brackets for Fire Extinguishers

1.2 ADMINISTRATIVE REQUIREMENTS

- B. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work. Include the following.
1. Rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Schedules: Schedule of units, using same room designations shown on drawings.
1. Product Schedule: Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements,:
1. Larsen's Manufacturing Company.
 2. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 3. Nystrom.
 4. Potter Roemer LLC.

2.2 PERFORMANCE

- A. California Compliance: Fabricate and label fire extinguishers to comply with California Code of Regulations Title 19, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

2.3 MATERIALS – GENERAL

- A. Single Source Responsibility:
 - 1. Obtain work from a single manufacturer.

2.4 FABRICATION

- A. Portable, Hand-Carried Fire Extinguishers:
 - 1. General:
 - a. Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
 - b. Valves: Manufacturer's standard.
 - c. Handles and Levers: Manufacturer's standard.
 - d. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
 - 2. Multipurpose Dry-Chemical Type:
 - a. UL-rated 4A-60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.
- B. Mounting Brackets:
 - 1. Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
- C. Identification:
 - 1. Identification sign acceptable to the Campus Fire Marshal
 - 2. Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 3. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a)Orientation: Horizontal.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.

END OF SECTION

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SECTION 11 3000

APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Refrigeration appliances.
 - 2. Microwave.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
- B. Sustainability Submittals:
 - 1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of appliance, from manufacturer.
- B. Field quality-control reports.
- C. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer
 - 1. Manufacturer shall have produced specified or similar products for a minimum of 5 years prior to bid, and have used products in similar scope, on projects of similar scale and type. Manufacturer shall have the capacity to produce and deliver products on schedule as required for the Work.
 - 2. Maintains, within 20 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- B. Installing Contractor Qualifications:
 - 1. Installing contractor shall be certified, licensed, or otherwise approved by manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
 - 2. Installing contractor shall have installed specified or similar products on a minimum of 5 projects of similar scale and type within 5 years prior to bid.
- C. Comply with all LEED documentation and reporting procedures established by Section 018113.
- D. Regulatory Requirements: Comply with the following:
 - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
- E. Accessibility: Comply with 2010 ADA Standards for Accessible Design and CBC, Chapter 11B
- F. Preinstallation Conference: Conduct conference at Project site.

1.7 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period except as qualified below:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 REFRIGERATOR – FULL SIZE

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

2. Or equal.

B. Series and Model Number:

1. Model No: Elite 79043
2. Finish: Stainless steel
3. Capacity: 24.1CF
4. Door Hand: Reversible.

2.2 MICROWAVE

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

1. GE
2. Or equal

B. Series and Model Number:

1. Model No: . PES7227SLSS

2.3 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Examine walls, ceilings, and roofs for suitable conditions where overhead exhaust hoods will be installed.

- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Anti-Tip Device: Install at each range according to manufacturer's written instructions.
- E. Utilities: Comply with plumbing and electrical requirements.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- C. An appliance will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION

SECTION 12 3661

SIMULATED STONE COUNTERTOPS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Solid-Surface-Material Countertops

1.2 ADMINISTRATIVE REQUIREMENTS

- B. Pre-installation Meetings:
1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.3 ACTION SUBMITTALS

- A. Product Data: Describe the properties of items to be used in the Work. Include the following.
1. Each variety of simulated stone, accessory, and manufactured product.
- B. Shop Drawings: Show fabrication and installation of the Work. Include the following.
1. Plans, sections, details, and attachments to other work.
 2. Locations and details of joints.
 3. Direction of veining, grain, or other directional pattern.
 4. Materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples:
1. Initial Selection: Furnish manufacturer's complete color selection showing full range of colors and finish characteristics. Furnish the following.
 - a. For each type of material exposed to view.
 2. Verification: Furnish materials to be used with labels indicating colors, finish characteristics, and locations of the Work. Samples will be reviewed for color and appearance only. Furnish the following.
 - a. Countertop material, 6 inch (152.4 mm) square.

1.4 INFORMATIONAL SUBMITTALS

- A. Sustainability Submittals:

1. Refer to Division 01 Section "LEED Requirements" for requirements.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops before countertop fabrication is complete.

1.6 CLOSEOUT SUBMITTALS

- A. Submit the following.
 1. Maintenance Data:
 - a. Maintenance Manual: Assemble into binder.
 - 1) Maintenance Practices: Manufacturer's recommended maintenance practices describing the materials, devices and procedures to be followed in cleaning and maintaining the Work.
 - 2) Names, addresses, and telephone numbers of local sources for products

PART 2 – PRODUCTS

2.1 FABRICATION

- A. Solid Surface Countertops:
 1. Configuration: Provide countertops with the following front and backsplash style:
 - a. Front: As indicated on Drawings.
 - b. Backsplash: As indicated on Drawings.
 - c. Endsplash: Matching backsplash.
 2. Countertops: 3/4 inch (19.05 mm) thick, solid surface material with front edge built up with same material.
 3. Backsplashes: 3/4 inch (19.05 mm) thick, solid surface material.
 4. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surfacing manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - a. Fabricate with loose backsplashes for field assembly.
- B. Miscellaneous:
 1. Adhesives: Adhesives shall not contain urea formaldehyde.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install system in accordance with manufacturer's printed installation instructions, submittals, applicable industry standards, and governing regulatory requirements for the Work.

END OF SECTION

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SECTION 21 0500

BASIC FIRE PROTECTION MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Materials, equipment, fabrication, installation, starting, testing and commissioning in conformance with applicable codes and authorities having jurisdiction for Fire Protection Work covered by all sections within this Division.
- B. Index of Division 21 Sections
 - 1. 21 12 00 – Standpipes and Hoses
 - 2. 21 13 00 - Fire Sprinklers
 - 3. 23 05 29 - Hangers and Supports
- C. Related Sections
 - 1. All work in every Section must also comply with such general conditions of the specifications as are applicable, including, but not limited to
 - a. Instructions to Bidders
 - b. General Conditions
 - c. Special Conditions
 - d. Supplementary Conditions
 - e. Division 1
 - 2. The provisions of Specification Section 230500 Basic Mechanical Materials and Methods apply to this Section and the work of this Division.
- D. BIM Modeling and Coordination
 - 1. Trade Contractor shall provide BIM modeling of their respective scope of work to establish the routing, layout, and coordination with other trades of their respective work in a BIM 3D model during the prior to any installation taking place. Models shall accurately reflect framing size, bracing size, location, orientation, connection details, and work of other trades, etc. The Construction Manager shall provide coordination feedback to all Contractors for complete coordination.
 - 2. See Section 23 05 00 1.01 E Basic Mechanical Materials and Methods for additional information.

PART 2 - PRODUCTS

See Division 21 Sections.

PART 3 - EXECUTION

See Division 21 Sections.

END OF SECTION

SECTION 21 12 00
STANDPIPES AND HOSES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This Section includes piping and equipment for the following building systems:
 - 1. Class I, standpipes, automatic, semi-automatic and manual. Also combination standpipes as allowed by IBC. See plans for systems.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.03 RELATED WORK AND REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, Division 1 Specification Sections, apply to this Section.
- B. Section 01 91 13 - Commissioning.
- C. Section 21 13 00 - Fire Sprinklers
- D. Divisions 22 and 23 Sections.
- E. Division 28 - Fire Alarm and Mass Notification system.

1.04 DEFINITIONS

- A. Fire Hose Connection: Valve with threaded outlet matching fire hose coupling thread for attaching fire hose.
- B. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 14 for obtaining approval from authorities having jurisdiction.

1.05 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design standpipes and obtain approval from University. Include minimum residual pressures at hydraulically remote outlets according to the following:
 - 1. NPS 2-1/2 Hose Connections: 100 psig.

- B. Components and Installation: Capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.

1.06 SUBMITTALS

- A. Product Data: For the following:
 1. Pipe and fitting materials and methods of joining for standpipe piping.
 2. Pipe hangers and supports.
 3. Piping seismic restraints.
 4. Valves, including specialty valves, accessories, and devices.
 5. Alarm devices. Include electrical data.
 6. Fire department connections. Include type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
 7. Fire Hose connections. Include size, type, and finish.
 8. Fire Hose Valve Cabinets.
 9. Fire department connection and hose valve locking caps.
 10. Pipe and valve identifications and signage.

- B. Fire-Hydrant Flow Test Report: As specified in "Preparation" Article.

- C. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Material and Test Certificate for Aboveground Piping "and" Material and Test Certificate for Underground Piping."

- D. Maintenance Data: For each type of standpipe specialty to include in maintenance manuals specified in Division 1.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from University.

- B. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer. Base calculations on results of fire-hydrant flow test.

- C. Professional Engineer Qualifications: A California professional engineer who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of fire-suppression piping that are similar to those indicated for this Project in material, design, and extent.

- D. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.

- E. Standpipe Components: Listing/approval stamp, label, or other marking by a testing agency

acceptable to authorities having jurisdiction.

- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- G. NFPA Standard: Equipment, specialties, accessories, installation, and testing complying with 2010 Edition of NFPA 14, "Standpipe and Hose Systems."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Specialty Valves and Devices:
 - a. Victaulic Co. of America.
 - b. Grinnell Corp.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Star Sprinkler Corp.
 - e. Viking Corp.
 - f. Or equal.
 - 2. Water-Flow Indicators and Supervisory Switches:
 - a. See Section 21 13 00 - Fire Sprinklers
 - 3. Fire Department Connections:
 - a. Potter-Roemer.
 - b. Elkhart.
 - c. Or equal.
 - 4. Hose Connections:
 - a. Potter-Roemer.
 - b. Elkhart.
 - c. Or equal.
 - 5. Fire-Protection-Service Valves:
 - a. See Section 21 13 00 - Fire Sprinklers.
 - 6. Keyed Couplings for Steel Piping:
 - a. Grinnell Corp.
 - b. Victaulic Co. of America.
 - c. Or equal.
 - 7. Keyed Couplings for Ductile-Iron Piping:
 - a. Victaulic Co. of America.
 - b. Grinnell Corp.
 - c. Or equal.

8. Keyed Couplings for Copper Tubing:
 - a. Grinnell Corp.
 - b. Victaulic Co. of America.
 - c. Or equal.
9. Fire Hose Valve Cabinets:
 - a. Potter-Roemer.
 - b. Guardian Fire Equipment, Inc.
 - c. Larsen Mfg. Co.
 - d. Or equal.

2.02 PIPING MATERIALS

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

2.03 PIPES AND TUBES

- A. Ductile-Iron Pipe: AWWA C151, mechanical-joint type; with cement-mortar lining and seal coat according to AWWA C104. Include gland, rubber gasket, and bolts and nuts according to AWWA C111.
- B. Standard-Weight Steel Pipe: ASTM A 53, ASTM A 135, or ASTM A 795; Schedule 40 in NPS 6 and smaller.
- C. In-Building Riser: Ames, Wilkins, or equal, Type 304 stainless steel, one piece construction 90 degree fitting with 6 Ft long extensions, complete with CIPS coupler on the inlet side complying with AWWA C900, and grooved-end on building side complying with AWWA C-606, 200 PSI rated.

2.04 PIPE AND TUBE FITTINGS

- A. Ductile-Iron Fittings: AWWA C110, ductile-iron or cast-iron type; or AWWA C153, ductile-iron, compact mechanical-joint type. Include cement-mortar lining and seal coat according to AWWA C104 and glands, rubber gaskets, and bolts and nuts according to AWWA C111.
- B. Cast-Iron Threaded Flanges: ASME B16.1.
- C. Cast-Iron Threaded Fittings: ASME B16.4.
- D. Steel, Threaded Couplings: ASTM A 865.
- E. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.
- F. Steel Flanges and Flanged Fittings: ASME B16.5.
- G. Steel, Grooved-End Fittings: UL-listed and FM global approved, ASTM A 47 (ASTM A 47M), malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.05 JOINING MATERIALS

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for pipe-flange gasket materials and welding filler metals.
- B. Ductile-Iron, Keyed Couplings: UL 213 and AWWA C606, for ductile-iron pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gaskets, and steel bolts and nuts.
- C. Ductile-Iron, Flanged Joints: AWWA C115, ductile-iron or gray-iron pipe flanges, rubber gaskets, and steel bolts and nuts.
- D. Steel, Keyed Couplings: UL 213 and AWWA C606, for steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gaskets, and steel bolts and nuts. Include listing for dry-pipe service for couplings for dry piping.

2.06 POLYETHYLENE ENCASEMENT

- A. Polyethylene Encasement for Ductile-Iron Piping: ASTM A 674 or AWWA C105, film, 0.008-inch minimum thickness, tube or sheet.

2.07 GENERAL-DUTY VALVES

- A. Refer to Division 23 Section "Valves" for gate, ball, butterfly, globe, and check valves not required to be UL listed and FM approved.

2.08 FIRE-PROTECTION-SERVICE VALVES

- A. General: UL listed and FM Global approved, with minimum 175-psig non-shock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.
- B. Gate Valves, NPS 2 and Smaller: UL 262; cast-bronze, threaded ends; solid wedge; OS&Y; and rising stem.
- C. Gate Valves, NPS 2-1/2 and Larger: UL 262, iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.
- D. Swing Check Valves, NPS 2 and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.
- E. Swing Check Valves, NPS 2-1/2 and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.
- F. Split-Clapper Check Valves, NPS 4 and Larger: UL 312, cast-iron body with rubber seal, bronze-alloy discs, and stainless-steel spring and hinge pin.

2.09 FIRE HOSE CONNECTIONS

- A. Description: UL 668, 300-psig minimum pressure rating, brass, hose valve for connection of fire hose. Include 90-degree angle pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 2-1/2 hose valve threads according to NFPA 1963 and matching local fire department threads.

1. Valve Operation: Nonadjustable type, unless pressure-regulating type is indicated.
2. Finish: Rough brass.
3. Locking Caps: Knox Secure Cap, or equal, 2-1/2" size, stainless steel construction. Provide with Knox keywrench. Coordinate with depth of hose valve cabinets.

2.10 FIRE DEPARTMENT CONNECTIONS

- A. Fire Department Connections: See Civil Drawings.
- B. Roof Outlet Manifold: UL 405; three-way cast-brass body with brass, wall, escutcheon plate; brass hose valves with lugged caps and brass chains; and brass, lugged swivel connections. Include outlets with threads according to NFPA 1963 and matching local fire department sizes and escutcheon plate with marking "STANDPIPE." Identification plate shall be red finish aluminum plate with white lettering. Escutcheon plate shall be red color with white lettering, all in accordance with AOA/Cal Trans/Building requirements.
- C. Locking Caps: Knox FDC Plug, or equal, 2-1/2" size, stainless steel construction. Provide with Knox keywrench.

2.11 FIRE DEPARTMENT HOSE VALVE CABINETS

- A. Potter-Roemer Fire Rated Model FRC1830, UL7N43 or equal, 10 inches deep x 24 inches x 24 inches, recessed type, 20 gauge steel, with full glass door, and 2-1/2" size angle hose valve. 20 gauge tubular steel door with 18 gauge frame and a continuous steel hinge. All components powder-coated with electro-statically applied, thermally-fused, white polyester finish. Glass door provided with clear tempered safety glass. Furnish and install decal, "FIRE DEPT. HOSE VALVE".

2.12 FIRE DEPARTMENT HOSE VALVE AND EXTINGUISHER CABINETS

- A. Potter-Roemer Fire Rated Model FRC1880, UL7N43, or equal, for 2-1/2" valve, portable extinguisher specified under Division 10. Size; 8 inches deep x 18 inches x 24 inches, recessed type, 20 gauge steel, with full glass door, and 2-1/2" size angle hose valve. 20 gauge tubular steel door with 18 gauge frame and a continuous steel hinge. All components powder-coated with electro-statically applied, thermally-fused, white polyester finish. Glass door provided with clear tempered safety glass. Furnish and install decal, "FIRE DEPT. HOSE VALVE AND EXTINGUISHER".

2.13 ALARM DEVICES

- A. General: Types matching piping and equipment connections.
- B. See Section 21 13 00 - Fire Sprinklers.

2.14 PRESSURE GAGES

- A. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch- diameter dial with dial range of 0 to 300 psig.

2.15 SIGNAGE

- A. Refer to Section 23 05 53, and as specified below.
1. FPPI, Tyco, Reliable, or equal: Provide at all control, drain and test valves with signs identifying the type of valve and the area (floor or portion of the building) affected by the valve. Signs shall be aluminum with red letters on white background. Letters are to be minimum 1 inch high. Submit the working for approval, for example "CONTROL VALVE SECOND FLOOR." The signs are to be hung by a chain from the valve.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Coordinate with work of other trades.
- B. See Section 01 91 13 Commissioning.
- C. Install In-Building Riser below concrete foundation wall with min. 5-inches clearance between bottom of foundation and top of pipe.

3.02 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 291. Use results for system design calculations required in "Quality Assurance" Article in Part 1 of this Section.
- B. Report test results promptly and in writing.

3.03 EARTHWORK

- A. Refer to Division 2 for excavating, trenching, and backfilling.

3.04 EXAMINATION

- A. Examine roughing-in for fire hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.05 PIPING APPLICATIONS

- A. Do not use welded joints with galvanized steel pipe.
- B. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- C. Underground Service-Entrance Piping: Use stainless steel piping and adaptor ends for connection to different piping material.

D. Standpipes: Use the following:

1. Class III: Black steel, standard weight steel pipe with threaded ends and black steel-fittings or grooved end with matching fittings.

3.06 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Fire-Protection-Service Valves: UL listed and FM approved for applications where required by NFPA 14.
 - a. Shutoff Duty: Use gate valves.
2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 14.
 - a. Shutoff Duty: Use gate, ball, or butterfly valves.
 - b. Throttling Duty: Use globe, ball, or butterfly valves.

3.07 JOINT CONSTRUCTION

- A. Ductile-Iron-Piping, Mechanical Joints: Assemble joints with couplings, gaskets and bolts according to coupling manufacturer's written instructions.
- B. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

3.08 SERVICE-ENTRANCE PIPING

- A. Stainless Steel, 90° elbow with 6 ft long extensions.

3.09 WATER-SUPPLY CONNECTION

- A. Coordinate with on-site work for exact location of fire water lateral and make final connection.

3.10 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- C. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

- D. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- E. Install drain valves on standpipes.
- F. Install alarm devices in piping systems.
- G. Piping must be adequately supported and braced to withstand sudden loads caused by flow due to opening of hose connections or sprinklers or flow from fire department connection to system.
- H. Hangers and Supports: Comply with NFPA 13 and 14 for hanger materials. Install according to NFPA 13 and 14.
- I. Earthquake Protection: Installed piping shall be seismically braced in accordance with NFPA 13 and 2010 California Building Code to protect piping system from earthquake damage.
- J. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.
- K. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

3.11 VALVE INSTALLATION

- A. Refer to Division 23 Section "Valves" for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and authorities having jurisdiction.
- B. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install reduced-pressure principle type backflow preventers instead of check valves in potable-water supply sources.

FIRE HOSE-CONNECTION INSTALLATION

- D. Install fire hose connections adjacent to standpipes, unless otherwise indicated.
- E. Install freestanding hose connections for access and minimum passage restriction.
- F. Install wall-mounting-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Locate hose such that there is no obstruction in spinning spanner wrench full 360 degrees.

3.12 CONNECTIONS

- A. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- B. Electrical Connections: Power wiring is specified and installed in Division 28.
- C. Coordinate for connection of fire protection alarm devices to building fire alarm control panel.

3.13 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14 and in Section 15050 "Basic Mechanical Materials and Methods."
- B. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14 and in Section 15075 "Mechanical Identification."
- C. Fire protection signs shall be aluminum, red background and white lettering.

3.14 FIELD QUALITY CONTROL

- A. Flush, test, and inspect standpipes according to NFPA 14, "Tests and Inspection" Chapter.
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.15 COMMISSIONING

- A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- B. Verify that specified tests of piping are complete.
- C. Verify that potable-water supplies have correct types of backflow preventers.
- D. Verify that hose connections and fire department connections have threads compatible with local fire department equipment.
- E. Verify that hose stations are correct type and size.
- F. Energize circuits to electrical equipment and devices.
- G. Adjust operating controls and pressure settings.
- H. Coordinate with fire alarm tests. Operate as required.
- I. Coordinate with fire-pump tests. Operate as required.

3.16 DEMONSTRATION

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
- B. Schedule demonstration with Owner with at least seven days' advance notice.

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SECTION 21 13 00

FIRE SPRINKLERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish all labor, materials, tools, and equipment to complete the automatic fire sprinkler system as hereinafter described, ready for service to the entire satisfaction of the University Fire Department. Provide hydraulically calculated systems as defined in 2010 Edition NFPA 13, and in accordance with State Fire Marshall requirements.
- B. The work includes, but is not necessarily limited to, the design, furnishing and installing of a complete Wet Sprinkler fire protection system and Combined Standpipe Class 1 (CSP) piping system, as shown and noted on the Drawings and specified herein. At completion of work, all systems shall be operational, tested and functioning in conformity with applicable codes and authorities having jurisdiction. In general, work shall include but not be limited to:
 - 1. The fire water main including piping and final connections to the fire main point of connection as indicated on the Civil Engineers Drawing.
 - 2. Provide underground connection to point of connection as indicated on the Civil Engineers Drawing for an automatic sprinkler system and standpipes system.
 - 3. A complete hydraulically calculated automatic wet pipe sprinkler system for entire buildings, in accordance with 2010 Edition of NFPA 13 and 2010 California Fire Code.
 - 4. Submit with sprinkler shop drawings; support details and structural calculation of seismic bracing and pipe restraint system for the sprinkler piping, stamped and signed by a registered structural engineer.
 - 5. Provide automatic wet fire sprinklers below and above suspended ceilings that have combustible material.
 - 6. Provide fire department hose inlets and roof outlets connections as shown on plan.
 - 7. All electrical signaling and alarm devices installed on the piping system shall be furnished under this section and connected to the fire alarm system under the Electrical Division on electrical work.
 - 8. Piping support and seismic bracing per NFPA 13.
 - 9. Fireproof sealing of all fire barrier penetrations per U.L. Building Materials Directory.
 - 10. Paint all exposed fire sprinkler piping, in accordance with Section 09910 requirements.
 - 11. Coordinate routing of sprinkler piping with the other trades for the project.
 - 12. Identification of valves and labeling of piping.
 - 13. Flushing and testing in accordance with NFPA 13.

14. Repair of all damages done to premise as a result of this installation and removal of all debris left by those engaged in this installation.
15. Repair leaks in piping and/or replace associated devices that are damaged during pressure testing work.

- C. Coordinate with Division 26 all electrical power and fire alarm signal connection requirements. Arrange and pay for all wiring and final connections between components installed under this section and Division 28.
- D. Provide contacts and appurtenances for interface with Building Control System.

1.02 RELATED WORK AND REQUIREMENTS

- A. Requirements of General Conditions, Division 1.
- B. Section 01 91 13 – Commissioning.
- C. Section 21 12 00 – Standpipes and Hoses.
- D. Section 23 05 00 – Basic Mechanical Materials and Methods.
- E. Section 230529 – Hangers and Supports.
- F. Section 23 05 53 – Mechanical Identification.
- G. Divisions 21 and 22 sections.
- H. Division 26 - Electrical
- I. Division 28 – Fire Alarm and Mass Notification system.

1.03 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
 1. B16.22 Wrought Copper and Bronze Solder Joint Pressure Fittings.
- B. American Society for Testing and Materials (ASTM)
 1. A53 Standard Specification for Pipe, Steel, black and Hot-dipped, Zinc-coated, Welded and Seamless.
 2. A135 Specification for Electric-Resistance-Welded Steel Pipe.
 3. A194 Specification for Carbon and Alloy Steel Nuts for Bolts for High pressure and High-Temperature Service.
 4. A320 Specification for Alloy Steel Bolting Materials for Low-Temperature Service.
 5. A795 Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 6. B88 Seamless Copper Water Tube.

- C. American Water Works Association (AWWA)
 - 1. C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - 2. C110 Gray Iron and Ductile Iron Fittings.
 - 3. C200 Steel Water Pipe 6" and larger.

- D. This installation shall conform to the latest edition (including all appendices) at the time of bid or each of the following:
 - 1. 2010 Edition NFPA 13, Installation of Sprinkler Systems.
 - 2. 2010 Edition NFPA 14, Standpipe and Hose Systems.
 - 3. 2010 NFPA 72 National Fire Alarm Code.
 - 4. 2010 California Building Code.
 - 5. 2010 California Fire Code.
 - 6. Latest Edition of the Underwriters Laboratories Fire Protection Equipment Directory.
 - 7. Factory Mutual Global Approval Guide.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

- 1) Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.05 DESIGN CRITERIA

- A. Determine the static and residual pressure for the site as required for accurate determination of system requirements. Base system calculations on the lowest expected static and residual pressure for the area.
 - 1. Measure test data for static and residual pressure. Test shall be made within the presence of the Campus Fire Marshal and at a time approved by the University.
 - 2. Provide calculations based on 20 percent minimum safety factor. Maximum velocity in piping should not exceed 15 feet per second.

- B. It is the intent of these Specifications and Drawings to provide for a complete and operating automatic fire protection sprinkler system in full compliance with the standards of the National Fire Protection Association as set forth in NFPA Pamphlet No. 13.

- C. Review Architectural and Structural Drawings to determine the extent of construction and resultant fire protection coverage to comply with NFPA. Interstitial spaces, if utilized, will require sprinkler protection.

- D. Provide fire sprinklers to protect all building overhangs greater than 4 feet wide, or as required by local authority.

- E. Provide additional fire sprinklers where required to meet the requirements of NFPA13. Coordinate with the work of other trades especially when it may create interferences and or obstructions requiring special protection, additional piping and heads and drains.
- F. The maximum permissible flow velocity through automatic sprinkler piping shall be 15.0 feet per second. The minimum starting pressure at the most remote sprinkler head shall be not less than 7 psi.
- G. Use of piping lighter than Schedule 10 is not allowed by the University.
- H. Design system for earthquake protection in required seismic zone.
- I. The initial building shall contain basic sprinkler coverage that can be modified and extended for the future build-out of unimproved spaces.
- J. Design shall comply with the University's Insurance Underwriters' requirements.

1.06 COORDINATION/SPECIAL CONSIDERATIONS

- A. Coordinate with other trades all equipment locations, pipe, duct and conduit runs, electrical outlets and fixtures, air inlets and outlets, and structural and architectural features. Provide information on location of piping and seismic bracing to all other trades as required for a completely coordinated project.
- B. Contract Drawings: All piping required for the sprinkler and standpipe systems is not shown, but general arrangement of system piping, required standpipes, outlets and valves, alarm valves and areas requiring sprinkler protection are shown.
- C. Provide high temperature sprinkler heads in all electrical rooms or other areas with elevated temperatures such as mechanical rooms.
- D. Avoid running sprinklers and piping over electrical equipment, and electrical panels.
- E. Coordinate Work among the trades in accordance with Section 01310 to avoid any interference with the effectiveness of the fire protection system. Shop drawings shall include elevations of equipment and piping to assure coordination. The fire protection system shall be coordinated with other trades to assure that conflicts will not arise with structural, mechanical, electrical or architectural features of the building.
- F. Coordinate with Division 26 - Electrical (Fire Alarm) to ensure full awareness of all locations of control valves, flow switches, tamper switches, alarm and signal switches and freeze protection equipment. All fire alarm devices shall be connected to building's fire alarm control panel.

1.07 QUALITY ASSURANCE

- A. In accordance with Section 23 05 00 – “Basic Mechanical Materials and Methods”
- B. Contractors Qualifications: The work shall be designed and performed by a California licensed contractor with a valid State of California C-16 license in the installation, testing and maintenance of automatic fire sprinkler system and the same company shall have been in the business of installing fire sprinkler system for a minimum of 5 years. Fire protection systems, shop drawings and calculations shall be prepared,

stamped and signed by a State of California registered Fire Protection Engineer.

- C. Welding Materials and Procedures: Conform to and comply with ASME BPVC Section IX, 29 CFR 1910.1027, and applicable State labor regulations.
- D. Provide Welder Certificate in accordance with AWS D1.1 for all personal that will be performing welding work for this installation.
- E. Requirements of Regulatory Agencies:
 - 1. CBC Compliance: Install fire protection systems in accordance with Section 903 "Automatic Sprinkler Systems".
 - 2. CBC Section 905 "Standpipe Systems".
 - 3. NFPA Compliance: Install fire protection systems in accordance with NFPA 13 "Standard for the Installation of Sprinkler Systems".
 - 4. NFPA Compliance: Install combination standpipe system in accordance with NPFA 14 "Installation of Standpipe and Hose Systems".
 - 5. FM Compliance: Comply with Factory Mutual "Approval Guide".
 - 6. UL Labels: Provide fire sprinkler piping products and equipment which have been approved and labeled by Underwriters' Laboratories.
 - 7. Fire Marshal Compliance: Install fire protection systems in accordance with State Fire Marshal and Campus Fire Marshal.
 - 8. Screw Thread Connections: Comply with local fire department/marshal regulations for sizes, threading, and arrangement of connections for fire department equipment to systems.
- F. Fire stop penetrations with an approved material as prescribed in IBC, Section 712 "Penetrations". Refer to Section 230529 for specifications.
- G. Installation of the sprinkler system shall not be started until complete plans and specifications including water supply information have been reviewed by the authority having jurisdiction and the University's Insurance Underwriter.
- H. At various stages and upon completion, the system must be tested in the presence of the enforcing agency.

1.08 SUBMITTALS

- A. See Section 01334 – Shop Drawings, Product Data and Samples.
- B. See Section 23 05 00 – "Basic Mechanical Materials and Methods".
- C. Submittals shall include, but not be limited to the following. All alarm devices shall clearly show the California State Fire Marshal (CSFM) listing numbers:
 - 1. Pipe and fittings.
 - 2. Valves.
 - 3. Sprinkler heads.

4. Gauges.
5. Sleeves and Escutcheons.
6. wFlow switches.
7. Tamper switches.
8. Alarm bells.
9. Pipe hangers and supports.
10. Identification signs.
11. Sprinkler head cabinets.
12. Seismic restraints and sway bracing.

D. Submit shop drawings as follows:

1. Prepare and submit preliminary drawing to the University showing the proposed location of the fire sprinkler heads coordinated with and in relation to the ceiling tile pattern, light fixture and duct inlets/outlets. Review of this drawing and the University Fire Marshal's review stamp thereon shall be a prerequisite for the preparation of further working plans.
2. Where sprinklers are located at suspended ceilings, spacing shall be as required by NFPA 13, and as follows: Sprinklers shall be symmetrically placed, centered in ceiling tiles, and equidistant between lights, diffusers, and other elements. Sprinklers shall be spaced closer than the maximum spacing allowed so that symmetry and even spacing are achieved. Sprinkler head locations where shown on reflected ceiling plans are for architectural aesthetic purposes. Submit exact locations on shop drawings. Type, size, arrangement, and configuration shall be subject to review and acceptance by the Fire Marshal.
3. Detailed working drawings and hydraulic calculations shall be prepared and submitted for approval before fabrication of the project. Working drawings shall be submitted in complete sets (partial submission will not be acceptable) and shall bear the Contractor's license stamp, identity of the system designer and computer program used in the calculation of hydraulic information.
4. Fire Marshal approval of submittals is for permission to proceed and does not authorize design, products or installation not conforming to referenced codes and standards and this specification. Substitutions or alternates require specific approval by the University.
5. Upon completion of the Work, the Contractor shall provide AutoCAD computer files and a set of Mylar film reproducible Record Drawings to the University's Representative. Refer also to Section 01789. Final approvals are subject to receipt of acceptable Record Drawings.

E. Calculations.

1. Calculations shall be done on standard 8-1/2 inch by 11inch sheets, all in accordance with NFPA 13, and shall indicate pipe numbers; beginning and end node points; all referenced on the shop drawings, include hose stream demand requirements, and system demand curves. Calculations shall be bound and indexed in a loose-leaf binder same as for operating and maintenance instructions. Calculations shall start at the point of the connection of the respective building fire service to on-site water main. Contractor shall verify in the field the exact fire flow and pressure conditions before starting work.

2. The sprinkler piping systems shall be sized based on hydraulically calculated flow densities (gpm) over the most remote area of operation (hydraulic rectangular area, sq ft), and sprinklers spacing ,as follows:
 - a. Light Hazard occupancy, 0.09 GPM/sq. ft. over the most remote 2,000 sq. ft. and a maximum of 225 sq. ft. per sprinkler, for the entire building, except Mechanical and electrical rooms.
 - b. Mechanical and Electrical Rooms: Ordinary Hazard, Group 1 occupancy, 0.15 GPM/sq. ft. over remote 1,500sq. ft., per NFPA 13 for rooms less than 1,500 square feet.
 - c. The max distance between sprinklers shall not exceed 15 feet.
 - d. The reduction of the remote area of application with the use of Quick Response Heads, as defined in NFPA 13, is not permitted.
 3. The Fire Sprinkler Designer is responsible for obtaining water supply test data from the Fire Department for use in system design. Preferred hydrant locations are with the non flowing hydrant upstream of the building lateral and the flowing hydrant downstream. Flows should be at least what are required for design. This may require one or both hydrant outlets and more than one hydrant be opened. Preferred test time is during high water use periods.
 4. Seismic Restraints:
The NFPA-13, Seismic sway bracing calculations horizontal force factor shall comply with the higher factor as indicated in Section 23 05 48, paragraph 1.03F;
Importance Factor for Seismic Loading (I_p) = 1.5 for Life Safety Systems.
- F. Submittals having any content that is incomplete or unclear will be returned without review or approval.
- G. Deferred Approval Documents: Do not proceed with fabrication or installation of fire sprinkler system until deferred approval documents have been approved by Fire Department and University Representative.
1. General: Provide detailed drawings, specifications, and calculations prepared by a State of California licensed professional engineer.
 2. University Representative Review: Make additions, changes and corrections as directed by University Representative and resubmit.
 3. Agency Review: Submit documents to Agency or Authority Having Jurisdiction. Make additions, changes and corrections required by Agency / Authority at no cost to University and resubmit to University Representative.
- H. Provide all necessary information to ceiling suspension work of Section 09100, to provide coordinated submittals.
- I. Discharge patterns and application data shall be included in submittals for sidewall, water curtain, and similar special purpose sprinklers.
- J. Provide temporary construction fire service in accordance with California Building Code, Section 904.6.

PART 2 - MATERIALS

2.01 MANUFACTURERS

- A. Manufacturers: Firms regularly engaged in manufacture of fire protection products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Provide piping materials and factory fabricated piping products of sizes, types, pressure rating, temperature ratings, and capacities as required. Provide sizes and types matching piping and equipment connections; provide fittings of materials that match pipe materials used in fire protection systems.
- C. Equipment to be furnished under this specification shall be essentially standard product of manufacturer. Where two or more units of same class of equipment are required, these units shall be products of a single manufacturer. However, component parts of system need not be products of same manufacturer.
- D. Manufacturers: Subject to compliance with requirements, manufacturer offering automatic sprinklers which may be incorporated in the work include the following:
 - 1. Victaulic
 - 2. Viking
 - 3. Tyco
 - 4. Reliable
 - 5. Or equal

2.02 VALVE AND ALARM SYSTEM IDENTIFICATION

- A. Provide identification complying with Division 15 Mechanical Identification section in accordance with the following listing:
 - 1. Fire Protection Valves: Brass valve tags.
 - 2. Fire Protection Signs: Provide the following signs:
 - a. At each sprinkler valve, including roof manifold, sign indicating what portion of system valve controls.
 - b. At each outside alarm device, sign indicating what authority to call if device is activated. Sign shall be red color aluminum plate with 1-inch high lettering.
 - c. Signs shall be aluminum with red background, and white lettering.

2.03 BASIC PIPES AND PIPE FITTINGS

- A. For Installation Underground to 12 Inches Aboveground: Ductile Cast Iron AWWA C111 and C151. Fittings shall be Ductile Iron, AWWA C110, and Class 250.
 - 1. Piping more than 5 feet from building may be Polyvinyl Chloride (PVC) water pipe; Class 200, DR-14; cast iron or ductile iron fittings, Ring-Tite joints. Pipe shall be listed as AWWA C900, UL listed, and FM listed.

2. In-Building Riser: Ames, Wilkins, or equal, Type 304 stainless steel, one piece construction 90 degree fitting with 6 Ft long extensions, complete with CIPS coupler on the inlet side complying with AWWA C900, and grooved-end on building side complying with AWWA C-606, 200 PSI rated.
- B. For installation above ground - Schedule 40 black steel pipe - in accordance with ASTM A-135 or A-53. Provide full throat forged or cast tees and elbows.
1. Mechanical tees, saddle fittings, bushings and mechanical sprinkler head fittings shall not be used.
 2. Interior piping 2" and smaller: ASTM A53, A135, Schedule 40 steel piping with threaded fittings.
 3. Interior piping 2-1/2" and larger: ASTM A53, A135, Schedule 40 black steel piping with roll grooved ends and ductile iron groove couplings and fittings, in accordance with NFPA 13, Table 3-3.1.
 4. Exterior piping exposed to the atmosphere: Use ASTM A795 galvanized steel piping for exterior locations.
 5. Flexible couplings shall be installed in accordance with NFPA 13. Victaulic, Anvil (Grinnell), or equal.
 - a. Rigid Type: Coupling housing cast with offsetting, angle pattern bolt pads.
 - b. Flexible Type: Use in accordance with NFPA 13, and where vibration attenuation and stress relief are required.
 6. Secure cutout disks, which are created by cutting holes in the walls of pipe for flow switches, fittings and non threaded pipe connections to the piping system hear to the pipe where they originated.
 7. Roll grooved or cut grooved piping with listed couplings and fittings may be used for pipe sizes 2-1/2 inches and larger.

2.04 PIPING SPECIALTIES

- A. Provide piping specialties complying with Division 23 Basic Mechanical Materials and Methods section in accordance with the following listing:
1. Pipe escutcheons
 2. Dielectric unions
 3. Pipe sleeves
 4. Sleeve seals

2.05 SUPPORTS AND ANCHORS

- A. Provide supports and anchors complying with Division 23 Basic Mechanical Materials and Methods sections, in compliance with referenced standards.
- B. Spacing and details of the support and bracing of fire sprinkler piping shall comply with NFPA 13, 2010 Edition. U-hook hangers used as sway bracing must have legs bent out 10 degrees and must have a slenderness ratio not exceeding 200.

- C. Refer to Section 23 05 48 for special seismic requirements in addition to minimum requirements indicated in referenced standards.
- D. Concrete Inserts: Hilti Kwik-Bolt TZ, Uni-Strut P-3200 continuous insert, M24 spot insert Kin-line, or equal. Do not use powder-actuated fasteners for support of overhead piping unless approved by University Representative.

2.06 VALVES

- A. Provide valves, UL listed, and FM Global approved in accordance with the following listing. Provide sizes and types which mate and match piping and equipment connections.
 - 1. Gate Valves: Provide iron body gate control valve, outside screw and yoke (OS&Y), 175-lb rated working pressure, of sizes indicated, to close by turning to the right and to be sealed with approved metal seals. Valves shall be iron body, bronze fitted. Valves 2 inches and smaller shall be threaded, and valves over 2 inches shall be flanged. For reference purposes, Stockham G-634, Nibco F-607-OTS, Kennedy, Stockham or equal.
 - 2. Butterfly Valve: Provide UL listed FM global approved butterfly valves (slow-close) with position indicators. Electric motor operated valves shall be normally open and shall fail in the open position. For reference purposes, Victaulic Series 705W, Nibco GD-4765-8N, Kennedy, Stockham or equal.
 - 3. Swing Check Valves: Provide UL listed flanged, swing type, iron body, bronze seat ring and disc ring, and 175 psi pressure rating. For reference purposes, Nibco G-917-W, Victaulic Series 717, Kennedy, Stockham or equal.
 - 4. Riser Drain Valves: Main Riser Drain valves shall be angle or globe type, bronze body, screwed, 200 psi pressure rating, 2 inches size, with renewable composition soft disc. For reference purposes, Nibco, Stockham, Fairbanks or equal.
 - 5. Auxiliary Drain Valve: Valves for auxiliary drains and University's Representative Test connections shall be globe type, bronze body, screwed, 200 psi pressure rating, 1 inch size, with a renewable composition soft disc, For reference purposes, Nibco, Stockham, Fairbanks or equal.
 - 6. For other valves refer to Section 22 11 16, 2.03 – Valves.

2.07 BACKFLOW PREVENTION ASSEMBLY

- A. Backflow prevention assembly and associated tamper switches are furnished and installed under Division 33, Civil Engineering work.

2.08 METERS AND GAUGES

- A. Provide meters and gauges complying with Division 22 Basic Mechanical Materials and Methods section or Piping Specialties, in accordance with the following listing:
 - 1. Pressure gauges, 0-300 psi range.

2.09 FIRE PROTECTION SPECIALTIES

- A. Provide fire protection specialties, UL listed, in accordance with the following listing. Provide sizes and types that match piping and equipment connections.

1. Install drains on main risers and auxiliary drains at all low points in the system.
2. One University's Representative test drain shall be installed for each sprinkler system.
3. Drains and University's Representative tests shall be at locations approved by the University Representative.
4. Drains and University's Representative tests shall be installed at locations as shown on the Drawings.
5. Provide drain line to sanitary sewer standpipe and P-trap assembly as located on Plumbing Drawings.
6. Five or fewer trapped heads will not require a drain valve but may be drained through a plugged fitting.
7. Drain valve shall be of the angle type. Install in accordance with the requirements of NFPA Pamphlet No. 13.
8. Pipe drain valves to a floor sink or to the other receptors as indicated on the drawings. Discharge shall be visible from sight drain fitting or open end drain pipe. Provide flushing connections at ends of all cross mains.
9. Flow Alarm: Furnish and install a flow alarm system for each main sprinkler riser as shown on the Drawings. The systems shall be complete with Potter Electric, Notifier, Viking or equal, flow switch. As part of Division 26, wire flow alarm to the fire alarm control panel. Provide 3/4-inch conduit and two #14 wires from the tamper switch to the fire department control panel.
10. Provide wiring between switch, electric alarm bell, and junction box. Provide junction boxes specified under Division 26. Wiring shall meet the requirements of Division 26. All controls shall be identified by permanent metal tags or other approved means. Alarm switch shall be UL or FM global approved and shall have adjustable retard mechanism and two sets of SPDT contacts. Wiring between electrical distribution panel and junction box will be provided under Division 26.
11. Water flow indicator for local alarm: UL approved suitable for variable pressure, complete with instantaneous recycling retard and electrical contacts for alarm system (number as required).
12. Supervisory Switch: Fit the control valves on the fire sprinkler risers with monitor switch, Grinnell Model F640, Viking or equal, with single pole double throw switch actuator installed to change switch position when OS&Y valve is being closed.
13. Alarm Bell: UL Listed, FM Approved, 10 inch electric fire alarm bell, 24VAC, weather-proof backbox, capable of 94 dB at 10 Ft distance. Provide bird guard around alarm bell in accordance with University of California Merced requirements.
14. As part of Division 26, wire supervisory switch to the fire alarm control panel. Provide 3/4-inch conduit and two #14 wires from the tamper switch to the fire department control panel.

2.10 AUTOMATIC SPRINKLERS

- A. Provide automatic sprinklers in accordance with the following listing. Provide fusible links for 165 degrees F. unless otherwise noted; UL or FM approved.

- B. Type: Spray pattern type, automatic closed type heads of ordinary degree temperature rating, except that sprinklers to be installed in vicinity of heating equipment shall be of temperature ratings required for such locations by NFPA 13, 2010 Edition.
- C. Sprinklers shall be UL Listed and/or FM global approved.
1. Exposed, unfinished ceilings locations: Provide upright type sprinklers
 2. Where heads are located at height of less than 8 feet above finished floor, or where heads are located in mechanical equipment areas, provide wire guards to protect heads from damage.
 3. Concealed locations: Provide upright type sprinklers for exposed piping, or pendent type heads for concealed piping.
 4. Sidewall Locations: Where required and where approved by the University Representative.
 5. Finished Ceilings: Locate at all ceilings with lay in acoustical tile ceiling and at plaster or gypsum board type ceilings; Semi recessed quick response pendent sprinkler, Victaulic Series V27, Central TY-B Series or Reliable model F1 Series. Chrome plate finish with white escutcheons.
 6. Sprinkler heads in wood ceiling shall have factory painted black trim (white trim everywhere else)
 7. Ceilings in exterior of Building: Provide sidewall fire sprinkler heads and white escutcheons.
 8. Where fire sprinkler heads are located in rooms with surface mounted lights, provide 2 piece adjustable sprinkler escutcheon, with adjustment from 1-7/8" to 3-1/8" below finished ceiling. Fire sprinkler drop nipple should be mounted 2-1/4" below the finished ceiling surface.
 9. Sprinkler heads in light hazard area shall be quick response type.
 10. Extended coverage sprinklers shall not be used.
- D. Sprinkler Cabinet and Wrench: Furnish steel, baked red enameled, sprinkler box with capacity to store sprinklers and wrench sized to sprinklers Viking, Reliable, Tyco, or equal. Spare sprinklers and wrenches called for under "Extra Stock." Locate cabinet next to sprinkler riser assembly.

2.11 SIGNAGE

- A. Fire Sprinkler Control Valve: Provide additional signage on door of janitor's room with sprinkler riser assemblies to read "FIRE SPRINKLER CONTROL VALVE INSIDE". Sign shall comply with Campus Standards, sign Type 3, see sheets A8.42 - A8.44 for UCM Sign Type Standards.
- B. Refer to Section 23 05 53 Mechanical Identification, and as specified below.
- C. FPPI, Tyco, Reliable, or equal: Provide at all control, drain and test valves with signs identifying the type of valve and the area (floor or portion of the building) affected by the valve.

Signs shall be aluminum with red letters on white background. Letters are to be minimum 1 inch high. Submit the working for approval, for example "CONTROL VALVE SECOND FLOOR." The signs are to be hung by a brass chain from the valve.

- D. For all hydraulically calculated systems, provide hydraulic nameplate in accordance with NFPA 13, FPPI, Tyco, Reliable, or equal. Provide a copy of hydraulic nameplates for facility operation in a bound binder after training.

PART 3 - EXECUTION

3.01 PRODUCT HANDLING AND PROTECTION

- A. Deliver packaged materials in their original, unopened wrapping with labels intact. Protect materials from water, the elements and other damage during delivery, storage and handling.

3.02 PREPARATORY PROVISIONS

- A. The Contractor shall be responsible for the examination and acceptance of all conditions affecting the proper construction and/or installation of the Work of this Section and shall not proceed until all unsatisfactory conditions have been corrected. Commencing work shall be construed as acceptance of all conditions by the Contractor as satisfactory for the construction and/or installation of the Work.

3.03 INSTALLATION OF FIRE SPRINKLER PIPING

- A. General: Comply with the requirements of the Division 22 sections and referenced NFPA standards for installation of fire sprinkler piping material. Install fire sprinkler piping products where shown, in accordance with the manufacturer's written instructions, and in accordance with recognized industry practices to ensure that fire sprinkler piping complies with requirements and serves its intended purpose.
- B. Coordinate with work of other trades to interface components of fire sprinkler piping properly with other work.
- C. Install In-Building Riser below concrete foundation wall with min. 5-inches clearance between bottom of foundation and top of pipe.
- D. Sprinkler heads serving balconies shall be supplied from inside the building.
- E. Install sectional valves in piping.
- F. Coordinate routing of sprinkler piping with other trades.
- G. Mount supervisory switches on each sectional valve.
- H. Install valved hose connections of the sizes indicated, or 3/4 inch size, if not otherwise indicated, on sprinklers at ends of branch lines and cross mains at locations where indicated.
- I. Seismic Restraints: Fire protection system shall be installed with seismic restraints in accordance with the details and requirements of NFPA 13, and CBC, California Building Code.

- J. Provide "end of line" sway brace as required by NFPA 13, 9.3.6, provide a typical detail for the "end of line" sway brace that will restrain the piping from vertical and lateral movement.
- K. Install drain piping at low points of fire sprinkler piping, in accordance with NFPA 13.
- L. Identification: Apply signs to control, drain, test and alarm valves to identify their purpose and function. Provide lettering size and style selected by Authority Having Jurisdiction.

3.04 SLEEVES AND FLASHINGS

- A. All sleeves shall be properly anchored in place during pouring of slabs. All pipe sleeves through water resistant floors shall extend at least 1-1/2 inches above the finished floor and shall be watertight with the pipes passing through the sleeves. Sleeves passing through all other floors shall be of sufficient length to be flush with bottom of slab and extend one inch above the finished floor, and shall be securely anchored to the slab.
- B. All piping passing through membrane water resistant walls and floors shall be provided with a water resistant type pipe sleeve, with Schedule 40 pipe extension or equal. Pack water resistant sleeves with white oakum and mastic.
- C. Wherever pipes are exposed and pass through walls, floors, partitions or ceilings, they shall be fitted with chromium plated cast steel escutcheons held in place with setscrews. Care shall be taken to protect the escutcheons during the course of construction.
- D. Sleeves in masonry or other walls shall be put in place as the construction progresses, avoiding the cutting of completed work.
- E. All piping passing through fire-rated assemblies shall be installed within fire-rated pipe sleeves.

3.05 INSPECTION

- A. Examine areas and conditions under which fire protection materials and products are to be installed.
- B. After completion of the fire protection installation and at the start of the guarantee period, execute the National Automatic Sprinkler and Fire Control Association, Inc. standard form of "Inspection Agreement", at no increase in Contract Sum, calling for four inspections of the sprinkler system during the guarantee year, plus the following maintenance to be performed during the course of the fourth inspection.
 - 1. Operating of all control valves.
 - 2. Lubrication of operating stems of all control valves.
 - 3. Operating of electrical alarms.
 - 4. Cleaning of alarm valves.
 - 5. Lubrication of Fire Department hose connection inlets.
- C. Fill out "Inspection Agreement" in triplicate after each inspection and send copies to the Owner, Insurance Carrier and Fire Department.

3.06 INSTALLATION OF BASIC IDENTIFICATION

- A. Install mechanical identification in accordance with Section 23 07 00.
- B. Install fire protection signs on piping in accordance with NFPA requirements.

3.07 INSTALLATION OF PIPES AND PIPE FITTINGS

- A. Install pipes and pipe fittings in accordance with NFPA 13 and Section 23 05 00 "Basic Mechanical Materials and Methods" where indicated, in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that piping systems comply with requirements and serve intended purposes.
- B. Coordination: Coordinate all piping, heads, and sprinkler work to Architectural, Structural, Mechanical, and Electrical Work. Conceal piping, except where so indicated otherwise or where absolutely necessary. Place exposed piping where required by the University Representative. Provide any offsets or additional piping required to coordinate this system with all other Work.
 - 1. If piping is installed such that it is exposed to view in any location normally available to the users of the building or the public, it shall be relocated and concealed to the University Representative's satisfaction, and at no additional cost to the University.
- C. Any differences or disputes concerning coordination, interference, or extent of work shall be decided by University Representative and his decision shall be final.
- D. Supply System: Provide supply connections as required to service the sprinkler system.
 - 1. Installation shall conform to the applicable requirements of NFPA 13 and CBC.
 - 2. Make joints as specified herein and in a manner approved by University Representative. Leave joints exposed until final inspection and tests have been made.
 - 3. Brace or clamp bends in accordance with the requirements. The clamp rods at the flange and spigot piece shall be long enough to pass through the flange.
 - 4. Before connection of sprinkler system to underground supply, flush supply connections out thoroughly in accordance with NFPA.
- E. Piping and Fittings Above Ground:
 - 1. Install pipe, fittings, and hangers in accordance with CBC requirements.
 - 2. Cutting structural members for passage of sprinkler piping or for pipe hanger fastening will not be permitted except on review of University Representative for each specific case.
 - 3. Holes through walls, floors, and ceilings shall be large enough to accommodate pipe expansion. Provide suitable plates at each hole to ensure the effectiveness of floor or wall as a fire stop. Foundation penetration shall have a 2-inch annular space around pipe sealed watertight.
 - 4. Provide long runs of pipe with suitable means to permit free movement due to expansion and contraction.

5. Make reduction in pipe sizes with one piece concentric tapered reducing fittings. Bushings will not be acceptable.
6. Couplings shall not be used except where the length of pipe between fittings exceeds 20 feet 0 inches.
7. Use flanged fittings in control valves and drain assembly and at the base of risers.
8. Use malleable iron unions of the ground joint type in looped sprinkler systems where pipe is 2 inches in diameter or smaller. Where loops larger than 2 inches are used, companion flanges shall be installed.
9. Special couplings approved for use in sprinkler systems may be used in place of unions and flanged connections where applicable.
10. Install sectional valves in inlet piping, at bottom of each riser, and in all loops as required.
11. Mount supervisory switches on each sectional valve.
12. Install pressure gages at top of each standpipe.
13. Install valved hose connections 3/4-inch size on sprinkler at ends of branch lines and cross mains.
14. Install University's Representative test connection at most remote point from riser.

3.08 FIELD QUALITY CONTROL

- A. Sprinkler Piping Flushing: Prior to connecting sprinkler risers for flushing, flush water feed mains, lead-in connections, and control portions of sprinkler piping. After fire sprinkler piping installation has been completed and before piping is placed in service, flush entire sprinkler system as required to remove foreign substances under pressure as specified in NFPA 13. Continue flushing until water is clear, and check to ensure that debris has not clogged sprinklers.
- B. Hydrostatic Testing: After flushing system, test fire sprinkler piping hydrostatically for period of 2 hours at not less than 200 psi or at 50 psi greater than system pressure where pressure is anticipated to be in excess of 150 psi. Check system for leakage of joints. Measure hydrostatic pressure at low point of each system or zone being tested. Hydrostatic test shall be witnessed by the Campus Fire Marshal. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to University Representative. At completion, carefully clean and adjust equipment and trim that are installed as part of this work. Leave systems and equipment in satisfactory operating condition. Repair or replace piping system as required to eliminate leakage in accordance with NFPA standards for "little or no leakage," and retest as specified to demonstrate compliance.

3.09 EXTRA STOCK

- A. Heads: For each style and temperature range required, furnish additional sprinkler heads, amounting to one unit for every 100 installed units but not less than 10 heads, in proportion to the total number of each style of head.
- B. Wrenches: Furnish two sprinkler wrenches for each type and size of sprinkler connection.

- C. Provide steel cabinet for storage of heads and wrenches.
- D. Obtain receipt from University that extra stock has been received.

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SECTION 23 05 00

COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The scope of work covered by these specifications includes the complete installation of all mechanical HVAC (Division 23) work for this project. The scope includes furnishing all drawings, specifications, calculations, design, equipment, material and labor necessary for complete and operable systems, including General Conditions and Division 1.

1.2 RELATED SECTIONS

- A. Section 230513 - Common Motor and Drive Requirements for HVAC Equipment
- B. Section 230529 - Hangers, Supports, and Seismic Restraints for Mechanical Equipment
- C. Section 230590 – Testing Adjusting and Balancing
- D. Section 230593 - Balancing for HVAC
- E. Section 230700 – Mechanical Insulation
- F. Section 233313 – Ducts
- G. Section 23 30 00 – Duct Accessories
- H. Section 233600 –Air Terminal Units
- I. Section 250000 – Energy Management and Control Systems

1.3 DESCRIPTION OF WORK

- A. The work includes but is not necessarily limited to the following general headings:
 - 1. Provision of all mechanical HVAC, plumbing, and fire protection systems for work of this project.
 - 2. Record as-built documents.
 - 3. Operations and maintenance manuals.
 - 4. Equipment and systems training for Owner's personnel.
 - 5. Testing and Balancing
 - 6. Determine all items and quantities required.
 - 7. Removal and Recycling of all existing equipment removed in the project.
 - 8. Provide complete, continuous, operational, and functioning systems.

9. Fully coordinate with work of other Sections, including field verification of elevations, dimensions, clearance, and access.
10. Repair of all damage done to premises as a result of this installation and removal of all debris left by those engaged in this installation.
11. All rigging, hoisting, transportation, and associated work necessary for placement of all equipment in the final location shown.
12. Disassembly and re-assembly of any equipment furnished under this Section, should this be required in order to move equipment into final location shown on the Drawings.
13. All labor, materials, tools, appliances and equipment that are required to furnish and install the complete installation for this Section of the work including that which is reasonably inferred.
14. Cooperation with other crafts in putting the installation in place at a time when space required is accessible.
15. Temporary scaffolding necessary for performance of the work in Divisions 21, 22, and 23.
16. Cutting and core drilling required for work of Divisions 21, 22, and 23, including locating of rebar or coordination of locating rebar with the Contractor.
17. Cutting, drilling, notching for installed systems.
18. Pipe sleeves for all holes in walls, floors, and ceilings, and cutting of floor slabs and slabs on grade.
19. Cooperation with and assistance to the Building Automation System Contractor as required to provide a complete and functional HVAC control system.
20. Counterflashing of roof penetration for work of Divisions 21, 22, and 23.
21. Sizes, and locations for installation of concrete curbs and pads for work of Divisions 21, 22, and 23.
22. Temporary and permanent stands, supports, and bases for equipment requiring them, including vibration isolation.
23. Temporary protection of existing installation.
24. Firestopping of penetrations of ducts, piping and conduits through walls, floors, and ceiling assemblies.
25. Temporary utilities as required to install work on Divisions 21, 22, and 23 including lighting, water, gas, electricity, etc.
26. Stenciling and equipment identification.
27. Fees, permits, inspections, taxes, and approach from agencies that have jurisdiction over installation of Divisions 21, 22, and 23.
28. See subsequent Sections for detailed descriptions.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- A. Codes: Provide work in accordance with appropriate standards, codes, and recommendations, including those of the following agencies:
 1. 2019 California Building Code
 2. 2019 California Plumbing Code
 3. 2019 California Mechanical Code.
 4. 2019 California Fire Code
 5. Latest edition, California Electrical Code
 6. 2019 California Energy Efficiency Standards
 7. Underwriters Laboratories (UL).

8. National Fire Protection Association (NFPA).
9. CALOSHA.
10. California Code of Regulations (CCR) Title 8, 9, 22, and 24.

- B. Energy Codes: All equipment, systems, and insulation installed in Divisions 21, 22, and 23 shall comply with the minimum requirements of 2016 California Energy Efficiency Standards.
- C. Nothing in the Contract Documents shall be construed to permit work not conforming to the applicable laws, ordinances, rules, regulations.
- D. When requirements of the Contract Document exceed requirements of applicable laws, ordinances rules, regulations, the requirements of the Contract Documents shall take precedence.

1.5 PERMITS, LICENSES, AND INSPECTIONS

- A. Permits: The contractor shall pay for all permits required by work under 22, and 23.
- B. Inspections: All work shall be regularly inspected and certificates of approval shall be delivered to the Owner.
- C. Forward all submittals to the Contractor for the Owner review together, at one time. Individual or incomplete submittals will not be acceptable.
- D. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment.
- E. Identify each substantial item by reference to the specification Section paragraph in which the items specified or drawing and detail number.
- F. Organize submittals in the same sequence as they appear in specification Sections, articles or paragraphs.
- G. Any mechanical, electrical, structural, or other changes required for the installation of any approved substantial equipment provided as part of the work of Divisions 21, 22, and 23 shall be made to the satisfaction of the Owner and Owner's Representative at no increase in contract price. Approval by the Owner of the substituted equipment and/or dimensional drawings does not waive these requirements. Submit drawings of equipment spaces showing substituted equipment prior to installation.
- H. Approval of equipment shall not be construed as authorizing any deviations from the approved contract documents unless the attention of the Owner and Owner's Representative has been directed to the specific deviations.
- I. Furnish upon request, complete installation instructions on all material and equipment to be provided a part of the Work of Divisions 21, 22, and 23 before commencing installation of same.
- J. As-Built Drawings:

1. Prepare two sets of reproducible prints, based on the Contract Record Drawings, showing "as-installed" conditions thereon. It is anticipated that these drawings will be based on the shop drawings.
 2. Certify to completeness and accuracy of the "as installed" information indicated on the reproducible prints with signature.
 3. As-built drawings shall be submitted in both hard copy and CAD file format.
- K. Within 30 days of the date of Final Inspection, deliver the Record Drawings and Specifications, and As-Built Drawings to the Owner.

1.6 OPERATING MANUALS

- A. After completion of balancing and testing and commissioning operations, instruct the Owner's maintenance personnel in the operation, adjustment and maintenance of the mechanical plant for a minimum of 8 man-hours, unless the Owner agrees to a shorter period.
- B. Submit three (3) copies of certificates signed by Owner's Representative, attesting to their having been instructed.
- C. Thirty (30) days before Owner's personnel assume operation of systems, submit six (6) sets of operating maintenance instructions, indexed manuals, and parts lists for all major equipment and that requires or for which the manufacturer recommends maintenance in a specified manner.
- D. Provide service manuals to the Owner 30 days prior to final acceptance. Manuals shall include the following information:
 1. Part numbers of all replaceable items.
 2. Manufacturer's cuts and rating data.
 3. Oiling, lubrication and greasing data.
 4. Belt sizes, type and lengths, pulley sizes.
 5. Test and balance reports.
 6. Serial numbers of all principal pieces of equipment.
 7. Suppliers' names, addresses and phone numbers.
 8. Settings for all controls, both control point and throttling range.

1.7 PRODUCT DELIVERY, STORAGE HANDLING

- A. Identify materials and equipment delivered to site to permit check against materials list and shop drawings.
- B. Protect from loss or damage. Replace lost or damaged materials and equipment with new at no increase in Contract price.

1.8 EXISTING SYSTEMS AND UTILITIES SHUT-DOWN

- A. After the Owner has taken occupancy of the building, give the Owner 2 weeks' advance notice, in writing, of need to shut off existing utility services or equipment interruptions. No system shutdown shall be permitted without the expressed written approval from the

Owner. Divisions 21, 22, and 23 shall plan the shutdowns well in advance. The Owner shall set the exact time for and execute shutdown. The request shall state what systems are to be shut down, what areas will be affected, how long the period will be, and what contingency plan is provided if the work cannot be completed within the specified time. This procedure must be established and followed in order to provide the Owner with the least amount of service interruption and the least amount of disturbance for the users of the affected areas.

1.9 SCHEDULING AND SEQUENCING

- A. Cooperate with other trades in putting this installation in place at a time when space required is accessible, and in such a manner that all other work in this space may be installed as intended for the project. Schedule work and cooperate with the others to avoid delays, interferences, and unnecessary work, conforming to the construction schedule, making the installation when and where directed.

1.10 TEMPORARY USE

- A. Should it become necessary to use the new portion of the system and the new equipment before the completion of this work, the Owner reserves the right to make use of same at its own risk and expense, but the temporary use of the equipment shall not constitute an acceptance of the plant or any part thereof in any way. The Owner will bear the cost of fuel and electrical current for such temporary use of the equipment.
 - 1. The Commissioning Agent will supervise the Contractor's commissioning work.
 - 2. Provide all labor and materials needed to operate systems during the commissioning period.
 - 3. Support of the commissioning process is included as a part of the total package of quality assurance and quality control for this project. Commissioning is to be integrated into the project as the process that oversees and verifies the functional performance of equipment, systems, and assemblies via observation and testing. Include coordination with and full participation in the commissioning process. The support work related to commissioning shall include but not be limited to field observations, factory and site tests, pre-start checks, start-up checks, functional test procedure review, functional performance testing, commissioning meetings, documentation, test interpretation, and deficiency correction. The details of these requirements are described in the above Sections and other referenced Sections and are hereby incorporated by reference into the work of this Divisions 21, 22, and 23.

1.11 SYSTEM ACCEPTANCE

- A. Final Review: Request a final review prior to system acceptance after:
 - 1. Completion of the installation of all systems required under the Contract Documents.
 - 2. Completion of the commissioning process.
 - 3. Completion of identification program.
 - 4. Completion of cleaning program.
 - 5. Satisfactory operation of all systems for a period of two weeks.
 - 6. Building Flush out.

- B. Acceptance shall be contingent on:
 - 1. Completion of final review and correction of all deficiencies.
 - 2. Satisfactory completion of the commissioning process.
 - 3. Satisfactory completion of a minimum of 10 working days acceptance test which shall demonstrate compliance with all performance and technical requirements of the Contract Documents.
 - 4. Satisfactory completion of the training program and submission of all manuals and drawings required by the Contract Documents.

1.12 GUARANTEE

- A. See Division 1. See subsequent Sections for additional requirements. Defective parts will be replaced at no cost to the Owner.

1.13 SUBSTITUTION OR PRODUCT NOT LISTED AS DESIGN BASIS

- A. Any products submitted as substitution or not listed as the design basis shall meet all mechanical performance, electrical demand, weight, overall dimensions, and acoustical performance. Products named in specifications do not relieve the Contractor's responsibility to meet the project requirement as specified in the Contract Document.

PART 2 - PRODUCTS

2.1 PIPE IDENTIFICATION MARKERS

- A. Seton, Gemco, Kolby, or equal.
- B. Pipe markers shall be made from outdoor grade acrylic plastic and shall attach to pipe by fully wrapping around it. Marker shall indicate fluid or gas in written form and show direction of flow.
- C. Wording, lettering size and color, marker background color, and color band color-coding shall be in accordance with this section.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Arrange to meet with the Owner's Representative at the job site before the work is started and discuss with them the various phases of the work and the procedure and preparation for testing and adjusting the systems.
- B. The general arrangement and location of piping, ductwork, apparatus, etc., is shown on the Drawings or herein specified. Minor changes may be necessary to accommodate other work, new or existing, that may conflict with this work. Install this work in harmony with these trades and fully coordinate all work.

- C. Visit the site of the work, take measurements, examine all areas where work is to be performed and get such other information necessary for proper execution of the work. Ascertain and check all conditions with the Drawings and Specifications, other trades, existing conditions and by what means the work is to be performed. No allowance shall subsequently be made for any extra expense due to failure or neglect to make such examination and correlation. Where revisions or changes in the existing work are required to permit the installation of new work, they shall be made at no additional cost to the Owner. No allowance shall be subsequently made for any error or omission on the part of the bidder in this connection.

3.2 ACCURACY OF DATA

- A. The Drawings indicate the general arrangement and location of piping, ducts, and equipment. Should it be necessary to deviate from arrangement or location indicated in order to meet architectural conditions or site conditions, or due to interference with other work, make such deviations as offsets, rises and drops in piping and ducts that may be necessary, whether shown or not, without extra expense to the Owner. Extreme accuracy of the data given herein and on the Drawings is not guaranteed. The Drawings and Specifications are for the assistance and guidance of this Section and exact locations, distances, and elevations shall be governed by actual site conditions.

3.3 COORDINATION ITEMS

- A. Coordinate mechanical work with that of other trades in order to:
 - 1. Avoid interferences between general construction, mechanical, electrical, structural and other specialty trades.
 - 2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of mechanical equipment.
- B. Understanding of Work
 - 1. The Contractor shall have studied, examined, and compared all of the contract documents, including all drawings and specifications. The contractor shall have a full understanding of how the work in this part is scheduled, phased, and installed with work of all other trades.
 - 2. The Contractor shall include in this installation all piping, ductwork, devices, and equipment that are necessary for complete and operating systems as specified and as required.
 - 3. Piping and ductwork from fixtures, outlets, and devices shall be connected full size to the nearest suitable main or riser.
 - 4. Certain installations may be presented as typical, and full details are not repeated for each case. Contractor shall provide complete installation as if full details apply to each and every case, and make adjustments to typical details to suit each specific installation as part of the basic work.
 - 5. Installation of work presented on the diagrams are applicable to the plans, and work depicted on the plans are applicable to the diagrams.
 - 6. If there is a discrepancy in the drawings or specifications, the contractor shall figure the work based on the most stringent requirements to complete the installation and obtain clarification from the Owner Representative before installation.

- C. Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
1. Coordinate mechanical systems, equipment, and materials installation with other building components.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 6. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible. All work shall be above ceilings or ceiling line.
 7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Coordinate with individual system requirements.
 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as is practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
 11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 12. Coordinate with the locations of electrical panels and avoid installing piping and ductwork over them. Electrical panels are purposely located and have priority for location. The contractor is responsible for all required piping and ductwork offsets to insure that the panels are located as designed and for any other conditions.
 13. Perform system modifications recommended by the Test and Balance Agency after recommendations are accepted by the Owner Representative.

3.4 MANUFACTURER'S DIRECTIONS

- A. Obtain and follow manufacturer's directions in all cases. Where manufacturer's directions are in conflict with the Drawings and Specifications, submit to Owner Representative for clarification before installing the work.

3.5 INSTALLATION

- A. Manufacturer's Directions: Follow manufacturer's directions covering points not shown on the drawings or specified herein. Manufacturer's directions do not take precedence over drawings and Specifications. Where these are in conflict with the drawings and Specifications, notify the Owner's Representative for clarification before installing the work.
- B. Carpentry, Cutting, Patching, and Core Drilling:
 - 1. Provide carpentry, cutting, patching, and core drilling required for installation of material and equipment specified in this division.
 - 2. No penetrations shall be sleeved, cut, or core drilled through concrete construction without a submittal indicating exact locations and sizes and specific written approval from the Owner's Representative or unless specifically shown on the Structural Drawings.
 - 3. It is the Contractor's responsibility to accurately size and locate all openings through the structure. The dimensions shown on the Structural Drawings are for general information only. Provide all specific sizes, dimensions, requirements, etc.
- C. Sleeves, Stubs, and Slab Penetrations: Comply with Section 232113 – Hydronic Piping and Valves, Section 230529 - Hangers, Supports, and Seismic restraints for HVAC Equipment, Section 230548 – Vibration Controls for HVAC Piping and Equipment, and Section 233000 – HVAC Air Distribution.
- D. Painting of Mechanical Equipment and Hardware:
 - 1. Comply with Division 9 – Finishes.
 - 2. Factory assembled products (not shop fabricated) shall be factory finish painted.
 - 3. Provide moisture resistant paint for all exterior painting.
 - 4. Colors shall be as shown on the drawings unless specified.
 - 5. Comply with individual Sections for other equipment to be painted.
 - 6. Repair damaged galvanizing, paint, or coatings. Use Z.R.C. (no known equal) cold galvanized compound for galvanized repairs.

3.6 QUALITY CONTROL

- A. Measurements: All materials installed shall be to exact field measurements as determined by Divisions 21, 22, and 23.
- B. The installation depicted on the Drawings is designed to fit tightly into work under other Sections or Divisions. It is the essence of this Contract that all work be completely coordinated with all other Sections or Divisions, and that all locations of pipes and ducts be exactly determined in the field and cleared with all other Sections or Divisions before the installation of these items is begun. No extra compensation will be made for failure to observe this clause.
- C. Adequate clearance for access to all operable devices and all automatic devices and for access to all lubrication points shall be maintained in all portions of the work.
- D. Provide access panels where shown and where required for access to all equipment and operable devices.

- E. Gauges, thermometers, and other indicating devices shall be installed so that they may be easily read from the floor.
- F. Finish work shall present a neat and workmanlike appearance.
- G. Protection of Equipment
 - 1. Take responsibility for damage to any of the work or premises before acceptance. Should any new or existing equipment become damaged, restore it to its original condition and finish before final acceptance. Damage incurred to the Owner's properties, neighboring properties, or to the work of other Divisions, caused by Divisions 21, 22, and 23, shall be replaced or repaired by, and at the expense of, Divisions 21, 22, or 23 to the satisfaction of the Owner's Representative. All exposed materials shall be clean at the time of acceptance of the project.
 - 2. During the prosecution of this contract, the existing adjacent buildings and lower floors of the library will be occupied and in use. Work done under this Contract must be performed without inconvenience to the Owner's and/or occupants insofar as possible. All building furnishings and equipment of whatever nature, shall be protected at all times and the spaces shall be left clean. Provide temporary dust tight protection wherever required. Provide protection against damage to roof and remove protective material at completion of work.
 - 3. Exercise care during construction to avoid damage or disfigurement of any kind. Protect equipment from dust and moisture prior to and during construction. The Contractor is cautioned that concrete finishing, painting, etc. in electrical rooms shall not proceed if unprotected equipment is installed.
 - 4. Where required or directed, construct temporary protection for equipment and installations for protection from dust and debris caused by construction.
 - 5. All protection shall be substantially constructed with the use of clean canvas, heavy plastic, visqueen and plywood, as required, and made tight and dust proof as directed.
 - 6. Repair by spray or brush painting, after properly preparing the surface, all scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used for such purposes.
 - 7. Failure to protect the equipment as outlined herein shall be grounds for rejection of the equipment and its installation.

3.7 ACCESS DOORS AND PANELS

- A. This Section is responsible for the number of doors required and their accurate placement for access to work of Divisions 21, 22, and 23.
 - 1. This Section is responsible for arranging equipment so that it is fully accessible and serviceable through ceiling tiles, access doors, panels, etc.
 - 2. The Section is responsible for any additional access panels beyond what is shown on the contract documents for complete access to all equipment including equipment which is relocated as a result of the coordination process or equipment that is provided as a result of design-build or performance requirements.
 - 3. This Section shall obtain approval from the Owner's Representative for any added or relocated access doors, panels, etc.

3.8 STENCILING AND IDENTIFICATION

- A. Each piece of equipment shall have a factory tag with serial number, model number, performance data, etc.
- B. Label each piece of equipment including pumps, fans, tanks, etc., with designations as directed by the Owner. Do not proceed with labeling without approval from the Owner Representative. Labels shall be engraved plastic, with royal blue background and 1/2" high white lettering. State equipment number and scheduled performance data. Attach to equipment with stainless steel screws.
 - 1. Stencil each duct leaving the mechanical area indicating fan unit, area(s), or room(s) served, and direction of air flow
 - 2. Stencil each duct branch leaving an air shaft at each floor with fan number, and identify it as a supply, exhaust, or return duct, and indicate direction of air flow.
- C. Post a framed and typewritten schedule of all abbreviations, pipe markers, valve tags, and lubricants used, with identification, shall be framed and posted in each Mechanical Equipment Room, where directed by the Owner.
- D. Identify all pipes with specified markers.
 - 1. Install markers on mains, at all branch take-offs, at wall floor penetrations, and adjacent to valves and cocks. Identify service in written form and with color coded direction arrows.
- E. Above grade: every 15 feet.
 - 1. Install pipe markers in accordance with the manufacturer's directions. The markers shall completely cover the circumference of the pipe and overlap itself. Attach circumferential color coded direction arrows overlapping one end of the marker.
- F. Valve Tags: Provide numbered, laminated plastic tags for valves installed under this Contract, sized 2" x 4" with royal blue background and 1/2" high white lettering. Each valve shall be tagged to indicate the valve number and its service. Fasten tags to valve with brass chain.
 - 1. Valve numbers required for all main valves, branch valves, zone valves, shut-off, reheat valves, and balancing valves. Include valve numbers, size, service, N.O. or N.C., and flow coefficient and/or GPM if applicable.
 - 2. On the as-built drawings, indicate the location and number of each tagged valve.
 - 3. Provide a computer file database in a form agreeable to the Owner, describing the valve, number, location, type of service, and specific duty of each tagged valve.
- G. Place warning signs on all machines driven by electric motors which are controlled by fully automatic starters. See Section 3320, Article 7, Subchapter 3, "General Industry Safety Orders", Title 8, California Code of Regulations.
- H. Smoke Dampers: At each smoke damper access panel, label "Fire/Smoke Damper" in minimum one inch high letters.

3.9 CLEANING AND INSPECTION

- A. Thoroughly clean and test all equipment and material before insulation is applied, systems tested, or put into operation.
- B. Cleaning shall be as specified under the specific Sections in Divisions 21, 22, and 23.
- C. The intent of this Specification is that all equipment and material furnished by Divisions 21, 22, and 23 shall be completely dust-free, clean and rust-free, and freshly painted when the final inspection is made.

3.10 LUBRICATION

- A. All lubrication points shall be accessible. Where this is impossible, provision shall be made for lubrication at an accessible location. Where oil is used, an oil level indicator and capped, vented filling connection shall be provided and firmly mounted in an accessible space and shall be connected to the bearing with pipe(s) as required. Where grease is used for lubricant, the pipe shall have a suitable lubricating fitting installed at the accessible end. All equipment shall be thoroughly lubricated before operation and at time work is accepted. All automatic dampers and control linkages shall be properly lubricated. Provide a typed list of all lubricants required for all installed equipment, local dealer, and lubrication schedule. Frame and mount lubrication schedule in mechanical equipment rooms or where directed.

3.11 INSTALLATION OF SEALANTS

- A. See Division 7 and Section 26 05 02 - Basic Materials and Methods.
- B. Where fire stopping is not required, seal all duct and pipe penetrations through walls and floors for noise/vermin control.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Pipe and duct hangers, supports and associated anchors
 - 2. Thermal hanger shields for insulated piping
 - 3. All carpentry, masonry and steel fabrication involved in making stands and supports for equipment installed under this Division, unless specified otherwise.
 - 4. Furnishing and setting of sleeves, rods, inserts, and support and bracing devices for all piping, ductwork and equipment installed under this Division.
 - 5. Sizes and locations of all housekeeping pads, piers, and curbs for work of this Division, unless shown or specified otherwise. See architectural and structural drawings for details.
 - 6. Concrete inertia bases where shown or specified for equipment under this Division.
 - 7. Complete closing and sealing of all openings around pipes and ducts furnished under this Division. Maintain all fire separations.

- B. Related Sections
 - 1. Section 23 05 00 – Basic Mechanical Materials and Methods

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers: ASME Section VIII – Boiler and Pressure Vessel Code – Pressure Vessels

- B. Pipe Supports: ANSI B31.1, Power Piping

- C. Duct Hangers: SMACNA Duct Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.

- B. Hangers, Inserts and Supports
 - 1. Midland-Ross Corp.: Superstrut
 - 2. Elcen Metal Products Company

3. Fee and Mason
4. ITT Grinnell Corporation
5. Kin-Line, Inc.
6. Unistrut
7. Superstrut
8. B-Line
9. Or equal

C. Miscellaneous Devices

1. Kopty
2. Wejit
3. Or equal

2.2 DUCT HANGERS AND SUPPORTS

- A. See Section 23 31 13 – Ducts

2.3 ROOF DUCT, PIPE, AND DUCT/PIPE SUPPORTS

- A. See Details on the mechanical drawings..
- B. See roof plan for nominal locations. These locations are indicated for general information only and are not limited to the specific count or locations shown.
- C. The Section is responsible for providing the necessary supports for each combination of ducts and pipes as well as the appropriate number and locations of the supports.

2.4 STRUCTURAL ATTACHMENTS

- A. Model Numbers are Superstrut, unless otherwise indicated
- B. Anchor Bolts: Size as specified for hanger rods
- C. Concrete Inserts
1. Malleable iron
 2. Place reinforcing steel through insert as recommended by manufacturer for recommended loads
 3. No. 452 or equal
- D. Beam Clamps
1. All with U-568 safety strap
 2. All with locknuts on
 - a. Set Screw
 - b. Hanger rod
 3. Bottom flange attachment
 - a. Loading 150 pound and less: U-563
 - b. Loading 150 pound to 300 pound: U-562
 - c. Loading more than 300 pound: U-560
 4. Top flange attachment

- a. Permitted only when bottom flange attachment cannot be used
 - b. Loading 400 pound and less: M-777
 - c. Loading more than 400 pound: M-778
- E. Welded Beam Attachments
1. No. C-780 or equal
- F. Side Beam Brackets
1. No. 542 or equal
- G. Hanger Rods
1. ASTM A575 Hot rolled steel
 2. ANSI B1.1 Unified Inch Screw Threads
 3. Threaded both ends, threaded one end, or continuous threaded
- H. Hanger Rod Fixtures
1. Turnbuckles: No. F-112 or equal
 2. Linked Eye Rod
 - a. Rod swivel
 - b. No. E-131 or equal
 3. Clevis: No. F-111 or equal
- I. Powder or Gas Actuated Anchors
1. Hardened steel stud with threaded shank; size of shank to match hanger rod size
 2. Use only with non-shock loads
 3. Maximum load safety factors:
 - a. Maximum anchor load: 100 pounds
 - b. Static loads - 5
 - c. Vibratory loads - 8-10
 4. For concrete and steel; not to be used for light weight concrete, brick or concrete block
 5. 10% testing rate required, testing by Contractor
 6. Omark Drivit or equal
- J. Expansion Shields
1. Carbon-steel anchors, zinc coated
 2. Stainless steel for corrosive atmospheres
 3. For normal concrete use
 - a. Self-drilling anchor
 - b. Sleeve anchor
 - c. Stud anchor
 4. For thin concrete use: wedge anchor
 5. For brick or concrete block use: sleeve anchor
 6. Maximum load safety factors
 - a. Static loads - 4
 - b. Vibratory loads - 8 - 10
 - c. Shock loads - 8 - 10
 7. Size to suit hanger rods
 8. ITT Phillips Red Head or equal

- K. Steel Deck Inserts
 - 1. Factory stud with
 - a. Clip
 - b. Spring
 - c. Coupling
 - 2. ITT Phillips Red-Head or equal

- L. Miscellaneous Metal
 - 1. Steel plate, shapes and bars: ASTM A36
 - 2. Steel pipe columns: ASTM A53, Schedule 40, black
 - 3. Bolts and nuts: regular hexagon-head type, ASTM A307, Grade A
 - 4. Lag bolts: square head type, Fed. Spec. FF-B-561
 - 5. Plain washers: round, carbon steel, Fed. Spec. FF-W.92
 - 6. galvanized outdoors.

- M. Sheet Metal Screws: Plated, size 10 minimum.

PART 3 - EXECUTION

3.1 ATTACHMENT TO STRUCTURE

- A. See structural drawings for additional requirements.

- B. Concrete
 - 1. Use inserts for suspending hangers from reinforced concrete slabs, walls and sides of reinforced concrete beams wherever practicable
 - 2. Set inserts in position in advance of concrete work
 - 3. Provide reinforcement rod in concrete for inserts carrying
 - a. Pipe over 4 inch
 - b. Ducts over 60 inches wide
 - 4. Where concrete slabs form finished ceiling, finish inserts flush with slab surface
 - 5. Where inserts are omitted, install hangers with expansion shields
 - 6. Through-deck support
 - a. Drill through concrete slab from below
 - b. Provide rod with recessed square steel plate and nut above slab
 - 7. Where permitted by University and only for revisions made after initial construction, powder actuated anchors or expansion shields may be used in lieu of inserts
 - a. In bottom of thick slabs
 - b. In thin slab construction, only in sides of beams
 - 8. Pre-Cast Concrete
 - a. Use pre-set inserts
 - b. Where inserts are not available, field drill through beam or joists at locations as directed by University's Representative
 - c. Through bolt side beam bracket to beam or joist
 - 9. Poured-In-Place Concrete
 - a. With metal form or underdeck
 - b. Before concrete is poured
 - 1) Field drill hole through metal deck

- 2) Provide bearing plate, nut and locknut on rod; or install factory-made steel deck inserts specified hereinbefore
 - c. After concrete is poured
 - 1) Install hangers with expansion shields
 10. Locate anchors at least six (6) bolt diameters from any edge condition and at least ten (10) bolt diameters from any other anchor. Provide a minimum of six (6) bolt diameters embedment into concrete, unless otherwise noted on the Drawings.
 11. Limit load at concrete-filled steel deck to no more than 750 pounds per flute per beam bay (approximately 7 feet). Weights exceeding this restriction to be supported from the steel structural elements using engineered spreaders attached to the structural steel.
 12. See Structural Drawings for additional restrictions for locating anchors.
 13. Conform to CBC for drilled-in expansion bolts.
 14. Submit for Structural review all pipe hanger locations, point loads and structural attachment details for pipes 6" and larger.
- C. Steel Beam Attachments
 1. Beam or channel clamps
 2. Do not cut or weld to structural steel without permission of structural engineer
 3. Attach at beam axis. Avoid eccentric loads wherever possible.
- D. Steel Deck Anchors
 1. Concrete filled: as specified above
 2. Decking without concrete
 - a. Through rod Support
 - 1) Weld to square plate, 1/4 in thick
 - 2) Plate to distribute load over minimum of two full cells
 - 3) Coordinate with floor layouts to clear cells with wiring
- E. Side Wall Supports
 1. Concrete walls
 - a. As specified for hangers
 2. Stud Walls
 - a. Toggle bolts
 - b. Studs welded to structural studs
- F. Support Spreaders
 1. Install spreaders spanning between structural members when hangers fall between them, and hanger load is too great for slab or deck attachment
 2. Spreaders may be one of methods listed below, or combination of both as required
 - a. Fabricated from structural channel
 - 1) End fittings bolted or welded
 - 2) Secure to structural members
 - a) As required by construction
 - b) As reviewed by Structural Engineer
 - b. Formed channels with fittings, Superstrut or equal
 - 1) Submit manufacturer's calculations for installation

G. Coordination

1. Install so that attachments to structure are made prior to fireproofing. If attachments must be made after fireproofing, then thoroughly clean area of fire proofing before welded or bolted attachments are made and replace fireproofing as necessary.
2. This Section is responsible for the proper selection and sizing of all support, bracing, and guiding elements of any single or trapeze systems that include duct, pipe, and/or electrical conduit or cable trays, including those in the laboratories. The Contractor shall retain the services of a specialty support system provided to evaluate all loads due to weight, seismic forces, thermal expansion, etc., and perform all calculations and prepare detailed shop drawings for complete support, bracing, guiding, and anchoring systems based on the layouts shown on the Drawings.
3. Set all machines and devices dead level, except where pitch or slope is specified or shown, and securely fasten to the structure unless shown otherwise. Use dry pack cement grout to obtain complete contact between structure and equipment. Provide steel bracing as shown and specified to resist earthquake loads.
4. Concrete Work: Pads, curbs, and piers for equipment furnished under this Division shall be located and sized under this Division and installed under DIVISION 3. Inform Division 3 that all concrete shall be finished and surface hardened. This Section is responsible that forms, anchors, embeds, embedded channels and bases are properly set in the correct location. Carefully lay out all anchor locations before concrete is poured.
 - a. Provide housekeeping pads for all equipment provided unless specifically indicated otherwise. Nominal size is 4 inches high unless indicated otherwise.

3.2 DUCT HANGERS AND SUPPORTS

- A. See Section 23 31 13 – Ducts

3.3 FIRESTOPPING

- A. All duct (without fire/smoke dampers) and pipe penetrations through fire-rated assemblies shall have either a "T" and or "F" rating per the California Building Code.
- B. Materials and installation shall comply with the latest edition "U.L. Fire Resistance Directory". See Section 078413 Penetration Firestopping.

END OF SECTION

SECTION 23 05 53

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included in this section:
 - 1. Identify valves, piping and equipment components of the mechanical systems to indicate their function and system served
- B. Related Sections
 - 1. Section 23 05 00 – Basic Mechanical Materials and Methods

1.2 REFERENCE STANDARDS

- 1. Pipe marker shall comply with ANSI A13-1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
 - 1. W.H. Brady
 - 2. Seton
 - 3. Marking Systems, Inc. (MSI)
 - 4. Or equal

2.2 DUCTWORK IDENTIFICATION

- A. Duct markers shall be stenciled onto insulation of duct with legend and flow arrow. Letters shall be 2 inches high
- B. Indicate duct function: Supply, return, exhaust

2.3 MANUFACTURER'S IDENTIFICATION

- A. Manufacturer's nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this specification. The nameplates of Contractor or distributor are not acceptable.
- B. Identify model number, size, capacity, electrical characteristics, serial number, etc.
- C. Leave nameplates clean, legible and with unobstructed view

2.4 VALVE IDENTIFICATION

A. Valve Tags

1. General: Identify valves with metal tags, legends to be stamped or embossed. It shall indicate the function of the valve and its normal operating position; such as:
 - a. "56 HW" (NUMBER AND CONTENT OF PIPE)
 - b. "ISOLATION" (VALVE FUNCTION)
 - c. "NO" (NORMAL OPERATION POSITION)
2. Not required at isolation valves located adjacent to equipment they isolate.
3. Size: Valve tags 2-inch diameter with 1/4-inch high letters
4. Material: Use 0.050 or 0.064-inch brass tags
5. Automatic Valves and Regulating Valves: Use 1/16-inch thick laminated 3-ply plastic, center ply white, outer ply red, "lamicoid" or equal. Form letters by exposing center ply
6. Valve Tag Directory: Include tag number, location, exposed or concealed, service, valve size, valve manufacturer, valve model number, tag material, and normal operating position of valve

2.5 EQUIPMENT IDENTIFICATION

A. Nameplates

1. Tag all scheduled and uniquely tagged mechanical equipment with engraved nameplates. Nameplates shall be 1/16-inch thick, 3 x 5 laminated 3-ply plastic, center ply white, outer ply black. Form letters by exposing center ply.
2. Identify unit with building number, unit mark as shown on equipment schedules on Drawings, and service. For example: 0252 - SF-1 SUPPLY FAN

PART 3 - EXECUTION

3.1 GENERAL

- A. Submit equipment tagging nomenclature and examples for approval by the university before proceeding with producing or installing tags.

3.2 DUCTWORK IDENTIFICATION

- A. Provide identification of all toilet exhaust, general exhaust, return and supply air ducts by means of stenciled lettering identifying contents and direction of flow
- B. Colors: Black lettering on white background
- C. Locations: Stencil identification in ducts coming out of shaft at each floor and in equipment rooms and every 30 feet of duct
- D. Application: Apply to clean surfaces free of dust, grease, oil or any other material which will prevent paint adhesion

3.3 Equipment Identification

- A. Nameplates: Attach to prominent area of equipment, either with sheet metal screws, brass chain, or contact cement as applicable
- B. Locate where conspicuously visible
- C. Identify equipment out of view behind access doors, in unfinished rooms on the face of the access door
- D. Properly identify each piece of equipment and controls pertaining thereto by nameplates mounted on equipment and controls using round head brass machine screws, pop rivets or contact cement. Cardholders in any form not acceptable
- E. Place warning signs on machines driven by electric motors which are controlled by fully automatic starters, in accordance with Article 3281, General Industry Safety Orders
- F. Nameplate Directory: Post final copy in Operation and Maintenance Manual

3.4 Thermostats

- A. Tag the inside cover of the thermostat with indelible ink identifying the terminal unit served.

END OF SECTION

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SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Operational testing and adjusting of air handling equipment
 - 2. Balancing of air distribution systems
 - 3. Adjustment of air terminal devices
 - 4. Flow testing, adjusting and balancing of hydronic systems.
 - 5. Flow testing, adjusting and balancing of Plumbing systems.
- B. Related Sections
 - 1. Section 23 05 00 – Basic Mechanical Materials and Methods
 - 2. Section 23 31 13 – Ducts
 - 3. Section 23 09 00 – Energy Management & Control Systems

1.2 REFERENCE STANDARDS

- A. National Environmental Balancing Bureau Procedural Standards
- B. Associated Air Balance Council National Standards
- C. ASHRAE Standard 111 Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilating, and Air-Conditioning Systems

1.3 QUALITY ASSURANCE

- A. Contractor shall be member of Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB)
- B. Contractor shall have satisfactorily balanced at least three systems of comparable type and size
- C. Prior to start of testing, adjusting and balancing, verify that required Project conditions are met
 - 1. Systems installation is complete and in full operation
 - 2. All pre-functional tests have been performed
 - 3. Equipment has been started and tested in accordance with manufacturers written installation instructions
 - 4. Doors and windows are in place or under normal traffic conditions

1.4 SUBMITTALS

- A. See Section 23 05 00 – Basic Mechanical Materials and Methods.
- B. Submit to University's Representative documentation that
 - 1. Contractor is a member of Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB).
 - 2. Contractor has satisfactorily balanced at least three systems of comparable type and size
 - a. Include list of such projects
 - b. Include sample forms for use in compiling and recording test and balance data
- C. Pre-Test Submittal
 - 1. At least 15 days prior to starting field work, submit paper copies of the following
 - a. Set of final report forms
 - 1) Complete with design conditions of all equipment and design flow rates for all equipment and devices to be balanced.
 - 2) Forms shall include blank entry space for all data requested in this Section. Carefully review requested data; standard balancing forms may not be acceptable.
 - 3) Verify that forms are in acceptable word-searchable electronic format per Section 23 05 00 – Basic Mechanical Materials and Methods.
 - b. Complete list of instruments proposed to be used
 - 1) Organize in appropriate categories
 - 2) Include data sheets for each
 - 3) Show
 - a) Manufacturer and model number
 - b) Description and use when needed to further identify instrument
 - c) Size or capacity range
 - d) Latest calibration date
 - c. Provide certification that
 - 1) All instruments have been calibrated prior to tests
 - 2) Instruments comply with requirements of AABC or NEBB for tests required
 - 3) Contractor is currently certified by AABC or NEBB
 - 2. Do not proceed with field work until the above submittal has been approved by University's Representative.
- D. Final Test & Balance Report
 - 1. At least 15 days prior to Contractor's request for final inspection, submit copies of final reports on approved reporting forms for review and approval by University's Representative. Once approved, provide required quantity of paper and electronic copies per 23 05 00 – Basic Mechanical Materials and Methods.
 - 2. Form of Final Reports
 - a. Fully completed report forms for all systems specified to be tested and balanced including at a minimum all data specified herein to be recorded
 - b. Each individual final reporting form must bear
 - 1) Signature of person who recorded data
 - 2) Signature of air balance supervisor of reporting organization

- c. When more than one certified organization performs total air balance services, firm having managerial responsibility shall make submittals.
- d. Identify instruments of all types that were used and last date of calibration of each.

1.5 PROJECT REVIEW

A. Pre-Construction Review

1. Complete during the first 8 weeks following bid award date.
2. Review following documents
 - a. Contract documents
 - 1) Drawings
 - 2) Specifications
 - 3) Addenda
 - 4) Change orders
 - b. Design intent documents
 - c. Submittal data
 - d. Shop drawings
 - e. Temperature control drawings
3. Assure that design intent and all sequences of operation are clearly understood.
4. Identify potential problems from standpoint of total system balance.
5. Review of specifications for
 - a. Scope of work
 - b. Special requirements
 - c. Items that will make balancing difficult or impossible
6. Review of Drawings for
 - a. Potential problems for total system balance
 - 1) Location of balancing devices
 - 2) Lack of balancing devices
 - 3) General System layout
 - 4) Architectural features
 - 5) Accessibility
 - b. Most effective system balance procedures
 - c. Scheduling and coordination requirements
7. Review of submittal data for
 - a. Completeness of data
 - b. Conformity with contract documents
 - c. Special instructions for use of balancing devices
 - d. Factors for flow meters
 - e. Limitations affecting accuracy of measurements
 - f. Balancing forms shall show design data and submittal data where different
 - g. Equipment performance data and curves
8. Review of shop drawings for potential problems for total system balance, as specified above for review of the contract Drawings.
9. Review of temperature control drawings for:
 - a. Thorough understanding of system functions
 - b. Determining most effective total system balance procedure for minimum control manipulation
 - c. Coordinate required control manipulation with EMCS installer

10. Submit report recommending addition and/or relocation of balancing devices, including, but not limited to
 - a. Volume dampers
 - b. Balancing valves
 - c. Pressure and temperature measuring points

- B. Construction Review
 1. Make on-site visits during progress of construction: Number of visits to be as required to perform the functions specified below.
 2. Purpose of review
 - a. Identify potential problem for performing total system balance
 - b. Identify modifications that will affect air total system balance
 - c. Schedule and coordinate total system balance with other work
 - d. Identify conditions that could create hazardous environment for building occupants
 3. Typical activities
 - a. Check that necessary balancing and measuring hardware is
 - 1) In place
 - 2) Located properly and accessibly
 - 3) Installed correctly
 - b. Identify and evaluate variations from system design
 - c. Record data from equipment nameplates
 - d. Identify and report possible restrictions in systems; such as
 - 1) Closed fire dampers
 - 2) Long runs of flexible duct
 - 3) Poorly designed duct fittings
 - 4) Questionable piping connections
 - 5) Others as may arise or based on contractor's experience
 - e. Verify that construction progress will not delay total system balance
 - f. Identify best location for duct Pitot tube traverses
 - g. Identify scaffolding needs.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified herein. If not otherwise noted, the following minimum requirements apply
 1. Volt-meter: plus or minus 1 percent scale
 2. Ammeter: plus or minus 1 percent scale
 3. Ohmmeter: plus or minus 0.1 percent scale for calibrating plus or minus 0.4 degrees Fahrenheit resistance temperature sensors, plus or minus 0.25 percent scale for calibrating plus or minus 1 degrees Fahrenheit temperature sensors, plus or minus 1 percent scale for measuring motor current
 4. Ultrasonic time-of-travel strap-on flow sensor: plus or minus 5 percent of reading
 5. Other flow sensors: plus or minus 2 percent of reading
 6. Water pressure gauge: plus or minus 1/2 percent scale, ASME Grade 2A

7. Watt meter, plus or minus 1/2 percent scale: 3 phase split core current transducers
 8. Temperature: plus or minus 0.4 degrees Fahrenheit
- B. All equipment shall be calibrated within 6 months of use, or according to the manufacturer's recommended interval, whichever is shorter, and when dropped or damaged. Calibration tags shall be affixed or certificates readily available and proof of calibration shall be included reports.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate with work of other trades.
- B. Coordinate all work with Commissioning Coordinator
 1. See Section 01 91 13 – Commissioning
 2. See Section 23 97 00 – Mechanical Commissioning
- C. Report to University's Representative any discrepancies or items not installed in accordance with the Contract Drawings pertaining to proper balance and operation of air and water distribution systems.
- D. Perform testing, adjusting and balancing in accordance with AABC or NEBB standards.
- E. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to Section 23 07 00 – Mechanical Insulation.
- F. Mark equipment settings with paint or other suitable, permanent identification material, including damper control positions, valve indicators, and similar controls and devices, to show final settings.

3.2 CONTROL SYSTEM COORDINATION

- A. See Section 23 09 00 – Energy Management & Control Systems (EMCS)
- B. System balance techniques in this Section rely on the operation of the EMCS. Test and balance agency shall coordinate schedule of work with EMCS installer to ensure test and balance work can be executed and completed in a timely manner.
- C. Cooperate with EMCS installer in determining operating conditions and setpoints, as indicated in this Section.
- D. Cooperate with EMCS installer in calibrating all airflow measuring devices.

- E. Obtain and receive training for required software from controls system vendor for setting calibration constants in terminal devices.

3.3 AIR SYSTEM BALANCING

A. General

1. Do not operate fan systems for test or balance until spaces served have been cleaned of dust and debris, to avoid contamination of supply air or return air paths and equipment.
2. Check that filters are installed, free of bypass, and clean; type as specified herein
 - a. Make allowance for air filter resistance at time of tests
 - 1) Pressure drop across filter banks midway between drop for clean and dirty filters at design airflow
 - b. For systems with construction prefilters and high efficiency final filters
 - 1) Perform all zone level balancing with only pre-filter installed, no final filter, and system operating on 100 percent outdoor air (if equipped with economizer).
 - 2) Immediately prior to occupancy, or to 100 percent outdoor air purge if that procedure is to be implemented; see Section 23 05 00 – Basic Mechanical Materials and Methods, replace prefilters with new clean filters and install final filters. With final filters in place, perform tests of air handling unit per Paragraph 3.4D followed by 100 percent outdoor air purge if required by Section 23 05 00 – Basic Mechanical Materials and Methods.
3. In cooperation with EMCS installer, set adjustments of automatically operated dampers and valves to operate as indicated.
4. Balance hydronic systems prior to air balance and have operational during air balance for air temperature measurements.

B. Air Outlets

1. Adjust diffusers' throw pattern, grilles and registers to pattern indicated on the Drawings.
2. Test and adjust each diffuser, grille and register to within plus or minus 10 percent of design requirements
 - a. Start with all dampers wide open.
 - b. Adjust dampers, starting with nearest to terminal unit or fan. Make adjustments using duct mounted volume dampers rather than dampers at diffuser face unless absolutely required.
 - c. At least one damper shall remain wide open at end of balance.
3. Plenum return air grilles or slots: No balance required
4. Read and Report
 - a. Tag each grille, diffuser and register and mark tag on copy of floor plan.
 - b. For each grille, diffuser and register, indicate tag, size, type, and effective area (where applicable).
 - c. Required velocity/cubic feet per minute
 - d. Initially tested velocity/cubic feet per minute
 - e. Finally tested cubic feet per minute after adjustments

C. Variable Air Volume Terminals and VAV Diffusers

1. Balancing contractor shall provide laptop computer or other device for communicating with EMCS system, using software provided by EMCS installer. Cooperate with EMCS installer to learn how to use software to calibrate EMCS zone controller.
2. Terminal calibration procedure listed below may be modified based on specific features or limitations of digital controller and recommendations of the controller manufacturer. Submit revised procedure for approval by University's Representative along with pre-test submittal per Paragraph 1.04C.
3. Calibration at maximum volume setpoints
 - a. Zero transmitter prior to each test.
 - b. Adjust EMCS calibration constants so that actual box and measured air flow rate at air outlets matches EMCS reading within 5 percent at
 - 1) Maximum cooling airflow rate
 - 2) Maximum heating airflow rate
4. Calibration at minimum volume setpoint
 - a. Test flow at minimum volume setpoint. If EMCS indicated flow deviates from measured air flow rate at air outlets by more than 10 percent
 - 1) Calibrate EMCS again if a second calibration point is available
 - 2) If EMCS can only calibrate to one point, adjust EMCS minimum volume setpoint so that measured air flow rate at air outlets equals desired minimum, even though this will cause EMCS to read improperly
5. Read and Report
 - a. Tag, manufacturer, and model
 - b. VAV maximum cooling flow rate, design and measured
 - c. VAV minimum flow rate, design and measured
 - d. VAV maximum heating flow rate, design and measured
 - e. EMCS calibration coefficients
 - f. Entering and leaving terminal static pressure at maximum cooling airflow
 - g. Entering and leaving terminal total pressure at maximum cooling airflow

3.4 NOISE LEVEL TESTING

- A. Provide an allowance for 8-band measurement of 4 rooms selected by the University's Representative.
 1. Measurements in the room shall be at the center of the room and 60 inches above the floor.

3.5 SPOT CHECKING

- A. Spot checks shall take place after test and balance work is complete and reports have been prepared and approved.
- B. Spot checks shall be witnessed by an University's Representative. Schedule spot checks with University's Representative at least 1 week prior to proposed test date.
- C. University's Representative shall select subsets of any tested and balanced air or hydronic system to be spot-checked on the day of tests without prior notice to the Contractor.
 1. Spot-checking will not require more than one working day.

2. If additional spot checks are requested by the University's Representative causing the time limit above to be exceeded, inform University's Representative and indicate added price to perform the additional tests. Do not include additional tests in initial bid.

D. Discrepancies

1. If any of the spot-check measurements differ more than 25 percent from those documented in test and balance reports, the Contractor shall completely rebalance the associated system. For balance discrepancies at or downstream of a VAV box, rebalance only is required at or downstream of that box.
2. If discrepancies as described above are found on more than 25 percent of the spot-checks for air systems, all air systems shall be rebalanced.
3. If discrepancies as described above are found on more than 25 percent of the spot-checks for hydronic systems, all hydronic systems shall be rebalanced.
4. Rebalance work shall be witnessed by an University's Representative at the option of the University's Representative.
5. All rebalance work shall be documented and documentation shall be resubmitted as specified above.
6. All rebalance work shall be provided at no additional cost to the University.

3.6 TRAINING UNIVERSITY PERSONNEL

- A. See Section 23 97 00 – Mechanical Commissioning.
- B. Go over the final Testing, Adjusting and Balancing Report, explaining the layout and the meanings of each data type.
- C. Discuss any outstanding deficient items in control, ducting, piping or design that may affect the delivery of air or water.
- D. Identify and discuss any systems or system components that are not meeting their design capacities.
- E. Discuss any temporary settings and steps to finalize them for any areas that are not finished or fully occupied.
- F. Any other appropriate points that may be helpful for facilities operations, relative to testing, adjusting and balancing or the mechanical systems.

END OF SECTION

SECTION 23 07 00
MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. HVAC and Plumbing Piping insulation
 - 2. HVAC and Plumbing Pipe insulation jackets
 - 3. Equipment insulation
 - 4. Ducts and plenums, thermal insulation
 - 5. Ducts, fire rated insulation
- B. Related Sections
 - 1. Section 23 05 00 – Basic Mechanical Materials and Methods

1.2 REFERENCE STANDARDS

- A. ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate
- B. ASTM C177 – Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- C. ASTM C335 – Steady-State Heat Transfer Properties of Horizontal Pipe Insulation
- D. ASTM C585 – Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe
- E. ASTM C921 – Properties of Jacketing Materials for Thermal Insulation
- F. ASTM E84 – Surface Burning Characteristics of Building Materials
- G. ASTM E96 – Water Vapor Transmission of Materials
- H. NFPA 255 – Surface Burning Characteristics of Building Materials
- I. SMACNA – HVAC Duct Construction Standards - Metal and Flexible
- J. UL 723 – Surface Burning Characteristics of Building Materials
- K. ASTM E 814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops

1.3 DEFINITIONS

- A. Duct Dimensions

1. Where acoustical liner is indicated on the Drawings the duct sizes indicated shall be clear inside dimensions unless duct size is specifically indicated as outside dimensions (OD)

1.4 QUALITY ASSURANCE

- A. Source Quality Control
 1. Service: Use insulation specifically manufactured for service specified
 2. Labeling: Insulation labeled or stamped with brand name and number
- B. Applicator: Company specializing in performing the work of this section with minimum three years experience
- C. Samples
 1. Submit duct and plenum liner sample.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Insulation: Fiberglass
 1. Owens-Corning Fiberglass Corporation
 2. Manville
 3. Certainteed Corporation
 4. Knauf
 5. Or equal
- C. Insulation: Elastomeric Closed Cell
 1. Armstrong World Industries, Inc.
 2. Rubatex Corporation
 3. Or equal
- D. Adhesives
 1. Foster Div. Amchem Products Inc.
 2. Childers Products Company
 3. Epolux Mfg. Corporation
 4. Insul-Coustic/Birma Corporation
 5. Armstrong 520 Adhesive
 6. Or equal
- E. Mechanical Fasteners
 1. AGM Industries, Inc.
 2. Miracle Adhesives Corporation
 3. Grip-Nail
 4. Or equal

2.2 GENERAL

- A. Energy Codes: The current versions of California Title 24 and California Building Code shall govern where requirements for thickness exceeds thickness specified
- B. All insulation materials, including jackets, facings, adhesives, coatings, and accessories are to be fire hazard rated and listed by Underwriters' Laboratories, Inc., using Standard UL 723 (ASTM E-84), (NFPA-255), (ASA A2.5-1963)
 - 1. Flamespread: maximum 25
 - 2. Fuel contributed and smoke developed: maximum 50
 - 3. Flameproofing treatments subject to deterioration from moisture or humidity are not acceptable
- C. Insulation and accessories shall not provide any nutritional or bodily use to fungi, bacteria, insects, rats, mice, or other vermin, shall not react corrosively with equipment, piping or ductwork, and shall be asbestos free: Duct lining shall meet ASTM C1136 and ASTM C665 for biological growth in insulation

2.3 MATERIALS

- A. Duct Insulation
 - 1. Duct Wrap With Vapor Barrier; Type DW-V
 - a. Insulation: ASTM C553 and C612; flexible, noncombustible blanket
 - 1) 'K' ('Ksi') value: ASTM C518, 0.24 at 75 degrees Fahrenheit (R=4.2 minimum) at indoor applications.
 - 2) 'K' ('Ksi') value: ASTM C518, 0.125 at 75 degrees Fahrenheit (R=8 minimum) at outdoor applications.
 - 3) Maximum service temperature: 350 degrees Fahrenheit
 - 4) Maximum moisture absorption: 0.20 percent by volume
 - b. Vapor Barrier Jacket - factory installed. (FSK)
 - 1) Kraft paper reinforced with glass fiber yarn and bonded to aluminized film
 - 2) Moisture vapor transmission: ASTM E96 Procedure E; 0.02 perm
 - 3) Secure with pressure sensitive tape
 - c. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive
 - 1) Flexible fiberglass wrap. 3/4 pounds per cubic foot
 - 2) Installed conductance: 0.30 BTU-inch/hr/square foot/degree Fahrenheit at indoor applications
 - 3) Installed conductance: 0.125 BTU-inch/hr/square foot/degree Fahrenheit at outdoor applications.
 - 4) Factory applied jacket
 - a) Foil-scrim-kraft laminate: Aluminum foil facing
 - b) Glass scrim reinforcing
 - c) Kraft paper backing
 - 5) Maximum vapor permeance: 0.02 perms
 - d. Owens-Corning All Service Faced Duct-Wrap or equal
 - 2. Duct Board Without Vapor Barrier; Type DB
 - a. Insulation: ASTM C612; rigid, noncombustible blanket

- 1) K (Ksi) value: ASTM C518, 0.23 at 75 degrees Fahrenheit (R=4.2 minimum) at indoor applications.
 - 2) 'K' ('Ksi') value: ASTM C518, 0.125 at 75 degrees Fahrenheit (R=8 minimum) at outdoor applications.
 - 3) Maximum service temperature: 350 degrees Fahrenheit
 - 4) Maximum moisture absorption: 0.20 percent by volume
 - b. Installed conductance: 0.23 BTU-inch/hr/square foot/degree Fahrenheit at indoor applications.
 - c. Installed conductance: 0.125 BTU-inch/hr/square foot/degree Fahrenheit at outdoor applications.
 - d. Thickness per Paragraph 3.5A Duct Insulation Type and Thickness Schedule
 - e. Owens-Corning Type 703 or equal
 3. Duct Board With Vapor Barrier; Type DB-V
 - a. Insulation: ASTM C612; rigid, noncombustible blanket
 - 1) 'K' ('Ksi') value: ASTM C518, 0.23 at 75 degrees Fahrenheit (R=4.2 minimum) at indoor applications.
 - 2) 'K' ('Ksi') value: ASTM C518, 0.125 at 75 degrees Fahrenheit (R=8 minimum) at outdoor applications.
 - 3) Maximum service temperature: 350 degrees Fahrenheit
 - 4) Maximum moisture absorption: 0.20 percent by volume
 - b. Vapor Barrier Jacket - factory installed (FSK)
 - 1) Kraft paper reinforced with glass fiber yarn and bonded to aluminized film
 - 2) Moisture vapor transmission: ASTM E96; 0.02 perm
 - 3) Secure with pressure sensitive tape
 - c. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive
 - d. Installed conductance: 0.23 BTU-inch/hr/square foot/degree Fahrenheit indoor applications.
 - e. 'K' ('Ksi') value: ASTM C518, 0.125 at 75 degrees Fahrenheit (R=8 minimum) at outdoor applications
 - f. Thickness per Paragraph 3.5A Duct Insulation Type and Thickness Schedule
 - g. Factory applied jacket
 - 1) Foil-scrim-kraft laminate
 - a) Aluminum foil facing
 - b) Glass scrim reinforcing
 4. Tie Wire: Annealed steel, 16 gage
- B. Duct Lining
1. Rectangular Duct Lining; Type AL
 - a. Material
 - 1) Insulation: ASTM C423
 - 2) 'K": ASTM C518, 0.23 at 75 degrees Fahrenheit (R=4.2 minimum) for indoor applications.
 - 3) 'K": ASTM C518, 0.125 at 75 degrees Fahrenheit (R=8 minimum) for outdoor applications.
 - 4) Maximum service temperature: 350 degrees Fahrenheit
 - 5) Maximum moisture absorption: 0.20 percent by volume

- 6) Thickness per Paragraph 3.5A Duct Insulation Type and Thickness Schedule
- 7) 1-1/2 pounds per cubic foot unless shown otherwise to be 3 pounds per cubic foot
- 8) Installed conductance: 0.25 BTU-inch/hr/square foot/degree Fahrenheit at indoor applications.
- 9) Installed conductance) 0.125 at outdoor applications.
- b. Interior air-side surface
 - 1) Smooth black neoprene or matte facing overlay on air side. Coating shall conform to NFPA 90A, ASTM C665, ASTM G21
 - 2) Suitable for velocity up to 4000 feet per minute
 - 3) Meet erosion test method described in UL publication No. 181
 - 4) Durable and mechanically cleanable
 - 5) EPA registered anti-microbial agent
 - 6) Certainteed Toughgard Duct Liner or equal
 - 7) Adhesives
 - a) Duct Insulation, Internal: Foster 85-60 or equal
 - b) Weld Pins: Duro-Dyne CP or equal
- 2. Duct Liner is to be tested for sound absorption per ASM C423 under Type-A mounting conditions.

	Octave-band Center Frequencies (Hz)							
Thickness	62	125	250	500	1000	2000	4000	8000
1-inch	0.05	0.11	0.28	0.68	0.90	0.90	0.90	0.90
2-inches	0.10	0.15	0.85	0.90	0.90	0.90	0.90	0.90

- 3. See Part 3 for special edge treatment and sample requirements.
- C. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions
- B. Coordinate with work of other trades
- C. Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness
- D. Install insulation where it cannot become wet. If insulation becomes wet, remove and dispose of properly and replace with new, dry insulation. Wetted insulation is not acceptable. Ensure insulation is dry before and during installation.

- E. Insulate flanges with insulation sleeve of same material as pipe insulation to cover flange and overlap insulation on adjacent piping
- F. Fiberglass insulation
 - 1. Provide insulation with factory applied vapor barrier jackets
 - 2. Butt edges neatly. ASJ with 3 inch minimum butt strips
 - 3. Longitudinal overlaps: Minimum 2 inch self sealing, double adhesive
 - 4. Apply additional jacket as specified
 - 5. For piping conveying fluids below ambient temperature finish with vapor barrier adhesive
- G. Elastomeric Tubing
 - 1. Provide insulation
 - 2. Butt edges neatly. Seal longitudinal and transverse joints with adhesive to maintain minimum vapor permeance. Adhesive shall be selected and applied in accordance with insulation manufacturer's recommendations.
 - 3. Apply additional jacket as specified
- H. Foamed glass insulation
 - 1. Provide insulation
 - 2. Butt edges neatly. Seal longitudinal and transverse joints with adhesive in accordance with insulation manufacturer's recommendations
 - 3. Secure insulation using metal bands or fiber-reinforced tape in accordance with manufacturer's recommendations for service temperature
 - 4. Apply weather barrier mastic or metal jacket as specified
- I. with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- J. Perform work at ambient and equipment temperatures as recommended by adhesive manufacture
- K. Protection: Protect against dirt, water, chemical, or mechanical damage before, during, and after installation. Repair or replace damaged insulation at no additional cost
- L. Paint all insulation exposed to ultraviolet light (sunlight); see Paragraph 2.3J.2
- M. All vapor barriers shall be continuous. Tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape.
- N. Joints between insulation and access shall be sealed with vapor barrier mastic
- O. See Section 23 21 12 – Heating and Cooling Piping
- P. See Section 23 31 13 – Ducts

3.2 EQUIPMENT INSULATION

- A. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Secure insulation to equipment with bands, welded-on anchors, ties or adhesive. Where access to equipment is required for testing or maintenance the insulation shall be installed so that it is removable and so that the vapor barrier can be remade after access.
- B. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- C. For cold equipment or equipment containing fluids below ambient temperature
 1. Insulate entire system
 2. Provide vapor barrier jackets, factory applied or field applied
 3. Finish with glass cloth and vapor barrier adhesive
 4. Cover with aluminum jacket where specified
- D. For equipment containing fluids above ambient temperature
 1. Insulate entire system
 2. Provide standard jackets, with or without vapor barrier, factory applied or field applied
 3. Finish with glass cloth and adhesive
 4. Cover with aluminum jacket where specified
 5. For hot equipment containing fluids 140 degrees Fahrenheit or less, do not insulate flanges and unions, but bevel and seal ends of insulation
 6. For hot equipment containing fluids over 140 degrees Fahrenheit, insulate flanges and unions with removable sections and jackets
- E. Finish insulation at supports, protrusions, and interruptions
- F. For equipment in mechanical equipment rooms or in finished spaces, finish with aluminum jacket
- G. Do not insulate over nameplate or ASME stamps; bevel and seal insulation around such
- H. General
 1. Apply insulation with edges tightly butted
 - a. Joints staggered and secured in place by steel bands
 - b. Where necessary weld on suitable anchors
 2. Seal with 520 adhesive
- I. Special considerations
 1. Strainers and suction diffusers: removable and replaceable covers to allow strainer removal
 2. Pumps: removable and replaceable covers to allow impeller replacement
 3. Provide sufficient clearance around openings for normal operation of equipment

3.3 DUCT & PLENUM INSULATION

A. Duct and Plenum Insulation Type and Thickness Schedule

Location	Cooling or Heat/Cool Supply	Heating-only Supply	Return	Exhaust
Concealed in ceiling or return air plenum (R=4.2)	1.5 inches DW-V	1.5 inches DW-V	—	—
In unconditioned spaces (R=8)	1.5 inches DW-V	1.5 inches DW-V	1.5 inches DW-V	—
Exposed within conditioned space	□	□	□	□
Lined duct on drawings (unless otherwise noted) (R=4.2)	1 inch 1.5 pounds per cubic foot AL	1 inch 1.5 pounds per cubic foot AL	1 inch 1.5 pounds per cubic foot AL	1 inch 1.5 pounds per cubic foot AL
Terminal cans	0.5 inches 1.5 pounds per cubic foot AL	0.5 inches 1.5 pounds per cubic foot AL	0.5 inches 1.5 pounds per cubic foot AL	—
Flex duct	By manufacturer	By manufacturer	By manufacturer.	—

3.4 NON-INSULATED DUCTWORK

- A. No insulation required for ducts so indicated in Duct Insulation Type and Thickness Schedule, plus
1. Exhaust ducts, unless shown to be lined
 2. Return air ducts in conditioned spaces, unless shown to be lined
 3. Outside air ducts
- B. Do not line ducts:
1. Where prohibited by codes
 2. Shower exhaust

3.5 DUCT INSULATION INSTALLATION

- A. General
1. Ensure that insulation is continuous through inside walls: See 15070 Mechanical Sound, Vibration, and Seismic Control for packing openings through walls
 2. Finish insulation neatly at hangers, supports and other protrusions
 3. Locate insulation joints or cover seams in least visible locations
 4. Where ducts run in groups too close to be individually insulated and finished
 - a. Completely fill all spaces between ducts with rigid or flexible insulating material

- b. Insulate and finish exterior surfaces of group as specified for particular service
- 5. Where ducts cannot be insulated after erection, insulate prior to installation
- 6. Where specified thickness of insulation and/or lining exceeds available thickness in single layer, provide insulation and/or lining in 2 or more layers with joints staggered
- 7. Preparation
 - a. Do not install covering before ductwork and equipment has been tested and reviewed
 - b. Ensure surface is clean and dry prior to installation
 - c. Ensure insulation is dry before and during application
- 8. Mechanical fasteners
 - a. Use spot weld anchors in all shop fabricated internally lined ducts
 - b. Adhered anchors
 - c. Clip off pin penetrations flush with insulation surface or facing
 - d. Seal pins and washers where pins penetrate vapor barriers
 - 1) With 4 inch square pieces of vapor barrier material to match facing
 - 2) Adhere with vaporseal adhesive
 - e. Spacing on rectangular ducts
 - 1) Typical of horizontal and vertical, unless otherwise specified
 - 2) Duct board
 - a) 3 inches in from edges
 - b) Intermediate fasteners: 12 inches on counter maximum spacing all directions
 - c) Not less than four pins per surface
 - 3) Duct wrap

Side Dimension	Maximum Spacing
24 inches and under	None required.
25 to 32 inches	Horizontal - none. Vertical: 1 row centered, 12 inches on center
33 to 48 inches	2 rows, 12 inches on center.
49 to 60 inches	3 rows, 12 inches on center.
61 inches and over	16 inches on center, all directions.

- 4) Duct wrap spacing applicable to flat surfaces of flat oval ducts
- 9. Provide 24 gauge sheet metal Z section frames over edges of duct and plenum lining
 - a. At access openings and doors
 - b. Along edges exposed to air flow

B. Rectangular Duct Wrap

- 1. Without vapor barrier
 - a. Comply with published recommendations of manufacturer and with following
 - b. Secure with 4 inch strips of adhesive, 8 inches on center

- c. For rectangular ducts 24 inches and wider, secure to bottom of duct with mechanical fasteners 18 inches on center
 - d. Wrap with 18 gauge galvanized wire, 16 inches on center
 2. With Vapor Barrier
 - a. Vapor barrier and sealing continuous without breaks. Vapor proof seal around supports and bracing
 - b. 2 inches lap strip at one end
 - c. Peel insulation for 2 inch lap strip along longitudinal joints
 - d. Seal lap strips with vaporseal adhesive; Foster's 85-60 or equal
- C. Round Duct Wrap
 1. General
 - a. Adhere flexible insulation to ductwork with adhesive applied in 6 inch wide strips on 16 inch centers
 - b. Provide 16 gauge annealed tie wire tied, spiral wound or half hitched at 16 inch centers
 - c. Overlap insulation 2 inches and seal joints and breaks with 2 inch lap of foil adhered over joint
 2. Apply duct wrap with vapor barrier as specified above for rectangular ducts
- D. Duct Board
 1. Comply with published recommendations of manufacturer
 2. Secure on top, sides and bottom of duct with mechanical fasteners, spacing as scheduled
 3. Secure with 4 inch strips of adhesive, 8 inch on center
- E. Rectangular Duct and Plenum Lining
 1. Insulate ducts where shown on the Drawings, on the inside
 2. Comply with SMACNA Duct Liner Application Standard, published recommendations of manufacturer, and following:
 3. Apply adhesive over 100 percent of surfaces to be lined
 4. The coated surface shall face air stream
 5. Surface adjacent to air flow, including at joints, to be uniformly flat
 6. Insulation on floors of plenums and large ducts where access is required shall be protected by wire mesh so that lining is not damaged when walked or crawled on.
 7. Blank-Off Panels: Insulation, enclosed with sheet metal on all sides; all joints with vapor barrier mastic and taped
 8. Volume Dampers: Where volume dampers do not allow for continuous insulation, terminate insulation clear of handle sweep and finish edges to maintain vapor barrier and to prevent damage to the insulation
 9. Treat all factory, shops and field cut edges with a high density spray on and/or brush-on mastic to lock in fibers and to keep the liner from tearing.
 - a. Submit duct sample of liner, its attachment, and edge treatment. Duct sample to be approximately 18" x 12" x 12" long. Sample to meet or exceed example on file with the Contractor. Approved sample will be on placed on file with the Contractor for inspection comparison purposes.
 10. Damaged areas replaced or heavily coated with adhesive
 11. Mechanical fasteners
 - a. Use weld pins
 - b. Install mechanical fasteners

- 1) Weld pins flush with liner surface. Weld pins spaced maximum of 12-inch on center in both directions and within 2 inches of all corners and joints, except where SMACNA Standard requires closer spacing
- 2) Within 2 inches of all edges
- 3) Minimum 4 pins per side
- 4) For field alterations of lined ducts, install adhesive and glued pins with washers. Clip-off pins after washers installed. Field installed pins shall be used for unusual conditions only and shall not exceed 1 percent of total pins.

3.6 PENETRATIONS THROUGH RATED WALLS

- A. Refer to drawings for penetrations of rated assemblies.
- B. Install per manufacturer's installation and listing requirements.

3.7 FIELD QUALITY CONTROL

- A. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship
- B. All vapor barriers shall be continuous; tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape
- C. See Section 23 31 13 – Ducts for protection of lined duct during construction
- D. See Section 07 84 12 – Penetration Firestopping.
- E. See Section 07 92 00 – Joint Sealants.

END OF SECTION

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SECTION 23 09 00

ENERGY MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install components for new added equipment expanding upon the building existing energy management and control system.
- B. The systems to be controlled or monitored under work of this Section include but are not limited to the following
 - 1. HVAC Systems
 - 2. Plumbing Systems
 - 3. Irrigation Systems
 - 4. Lighting
 - 5. Building Electrical Systems

1.2 RELATED WORK AND REQUIREMENTS

- A. Section 23 05 00 - Basic Mechanical Materials and Methods
- B. Section 23 36 00 - Air Terminal Units
- C. Section 23 37 00 - Air Outlets and Inlets
- D. Testing and Commissioning
 - 1. Section 01 91 00 - Commissioning
 - 2. Section 23 05 93 - Testing, Adjusting and Balancing
 - 3. Section 23 97 00 - Mechanical Commissioning
 - 4. Section 26 08 00 - Electrical Commissioning
- E. Integration with Existing Campus System
 - 1. Include all services required to integrate this building into existing EMCS for a fully operational system.
 - 2. Procedure
 - a. Provide all controls work within the building as indicated on Drawings and in this Section.
 - b. Develop all building level control system databases and control programming using existing standards and standard programming.
 - c. Install building databases and control programming on a temporary portable operator's terminal provided by the Contractor. The POT shall be used for start-up, testing, and commissioning. The POT shall remain the property of the Contractor after final completion of the project.
 - d. Once the building EMCS has been fully commissioned and accepted by the University, merge database and programming with those existing on the

Control System Servers. Confirm that the merge was successful by sample testing points and sequences, and approve final installation in writing.

- e. Integrate graphic screens into the Central Plant graphics including adding appropriate hyperlinks so that the system operates as one integrated system.

1.3 REFERENCE STANDARDS

- A. Nothing in Contract Documents shall be construed to permit Work not conforming to applicable laws, ordinances, rules, and regulations. When Contract Documents differ from requirements of applicable laws, ordinances, rules and regulations, comply with documents establishing the more stringent requirement.
- B. The latest published or effective editions, including approved addenda or amendments, of the following codes and standard shall apply to the EMCS design and installation as applicable.
- C. State, Local, and City Codes
 1. CBC – California Building Code
 2. CMC – California Mechanical Code
 3. CEC - California Electrical Code
 4. Local City and County Codes
- D. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 1. ANSI/ASHRAE 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.
 2. ANSI/ASHRAE Standard 15 - Safety Standard for Refrigeration Systems.
- E. Electronics Industries Alliance
 1. EIA-232 - Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 2. EIA-458 - Standard Optical Fiber Material Classes and Preferred Sizes
 3. EIA-485 - Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
 4. EIA-472 - General and Sectional Specifications for Fiber Optic Cable
 5. EIA-475 - Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
 6. EIA-573 - Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
 7. EIA-590 - Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications
- F. Underwriters Laboratories
 1. UL 916 - Energy Management Systems
- G. National Electrical Manufacturers Association
 1. NEMA 250 - Enclosure for Electrical Equipment
- H. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems
2. IEEE 802.3 - CSMA/CD (Ethernet - Based) LAN
3. IEEE 802.4 - Token Bus Working Group (ARCNET - Based) LAN

1.4 DEFINITIONS

A. Acronyms

AAC	Advanced Application Controller
AH	Air Handler
AHU	Air Handling Unit
AI	Analog Input
ANSI	American National Standards Institute
AO	Analog Output
ASC	Application Specific Controllers
ASCII	American Standard Code for Information Interchange
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
A-to-D	Analog-to-Digital
BACnet	Data Communications Protocol for Building Automation and Control Systems
BC	Building Controller
BIBB	BACnet Interoperability Building Blocks
BTL	BACnet Testing Laboratory
CAD	Computer Aided Drafting
CHW	Chilled Water
CHWR	Chilled Water Return
CHWS	Chilled Water Supply
COV	Change of Value
CSS	Control Systems Server
CU	Controller or Control Unit
CV	Constant Volume
CW	Condenser Water

DBMS	Database Management System
DDC	Direct Digital Control
DHW	Domestic Hot Water
DI	Digital Input
DO	Digital Output
D-to-A	Digital-to-Analog
EMCS	Energy Management and Control System
EMT	Electrical Metallic Tubing
EP	Electro-Pneumatic
ETL	Edison Testing Laboratories
GUI	Graphical User Interface
HHD	Hand Held Device
HOA	Hand-Off-Automatic
HTTP	Hyper-Text Transfer Protocol
HVAC	Heating, Ventilating and Air-Conditioning
HW	Hot Water (plumbing)
HHW	Heating Hot Water
HHWR	Heating Hot Water Return
HHWS	Heating Hot Water Supply
I/O	Input/output
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
LAN	Local Area Network
LANID	LAN Interface Device
LCP	Lighting Control Panel
MAC	Medium Access Control
MHz	Megahertz
MS/TP	Master-Slave/Token-Passing
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology

ODBC	Open Database Connectivity
OI	Operator Interface
OWS	Operator Workstation
P	Proportional
PC	Personal Computer
PI	Proportional-Integral
PICS	Protocol Implementation Conformance State- ment
PID	Proportional-Integral-Derivative
POT	Portable Operators Terminal
PTP	Point-to-Point
RAM	Random Access Memory
SOO	Sequence of Operation
SQL	Standardized Query Language
SSL	Secure Socket Layers
TAB	Test, Adjust, and Balance
TDR	Time Delay Relay
UL	Underwriters' Laboratories, Inc.
XML	Extensible Markup Language

B. Terms

Term	Definition
Accessible	Locations that can be reached with no more than a ladder to assist access and without having to remove permanent partitions or materials. Examples include inside mechanical rooms, mechanical equipment enclosures, instrument panels, and above suspended ceilings with removable tiles.
BACnet Interoperability Building Blocks	A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device in a specification.
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.
Change of Value	An event that occurs when a digital point changes value or an analog value changes by a predefined amount.

Term	Definition
Client	A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.
Concealed	Embedded in masonry or other construction, installed in furred spaces, within double partitions, above hung ceilings, in trenches, in crawl spaces, or in enclosures.
Continuous Monitoring	A sampling and recording of a variable based on time or change of state (such as trending an analog value, monitoring a binary change of state).
Contract Documents	Specifications, drawings, and other materials provided with request for bids.
Control Systems Server	A computer(s) that maintain(s) the systems configuration and programming database.
Controller or Control Unit	Intelligent stand-alone control panel. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate.
Direct Digital Control	Microprocessor-based control including Analog/Digital conversion and program logic.
Energy Management and Control System	The entire integrated management and control system.
Equal	Approximately equal in material types, weight, size, design, quality, and efficiency of specified product.
Exposed	Not installed underground or concealed
Furnish	To purchase, procure, acquire and deliver complete with related accessories.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Hand Held Device	Manufacturer's microprocessor based portable device for direct connection to a field Controller.
Inaccessible	Locations that do not meet the definition of accessible. Examples include inside furred walls, pipe chases and shafts, or above ceilings without removable tiles.
Indicated, shown or noted	As indicated, shown or noted on drawings or specifications
Install	To erect, mount and connect complete with related accessories.
Instrumentation	Gauges, thermometers and other devices mounted in ductwork or piping that are not a part of the EMCS.

Term	Definition
IT LAN	Reference to the facility's Information Technology network, used for normal business-related e-mail and Internet communication.
LAN Interface Device	Device or function used to facilitate communication and sharing of data throughout the EMCS.
Local Area Network (LAN)	Computer or control system communications network limited to local building or campus.
Master-Slave/Token Passing	Data link protocol as defined by the BACnet standard.
Motor Controllers	Starters, variable speed drives, and other devices controlling the operation of motors
Native BACnet Device	A device that uses BACnet for communication. A device may also provide gateway functionality and still be described as a Native BACnet device
Native BACnet System	A network composed only of Native BACnet Devices without gateways
Open Database Connectivity	An open standard application-programming interface for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system is handling the data.
Open Connectivity	OPC is an interoperability standard developed for industrial applications. OPC compliant systems make it possible to access or exchange data from any application, regardless of which database management system is handling the data.
Operator Interface	A device used by the operator to manage the EMCS including OWSs, POTs, and HHDs.
Operator Workstation	The user's interface with the EMCS system. As the EMCS network devices are stand-alone, the OWS is not required for communications to occur.
University	The University or their designated representatives.
Piping	Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and related items
Points	All physical I/O points, virtual points, and all application program parameters.
Point-to-Point	Serial communication as defined in the BACnet standard.
Portable Operators Terminal	Laptop PC used both for direct connection to a controller and for remote dial up connection.

Term	Definition
Primary Controlling LAN	High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.
Protocol Implementation Conformance Statement	A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device.
Provide	Furnish, supply, install and connect up complete and ready safe and regular operation of particular work referred to unless specifically noted
Reviewed, approved, or directed	Reviewed, approved, or directed by or to University's Representative
Router	A device that connects two or more networks at the network layer.
Secondary Controlling LA	LAN connecting AACs and ASCs. Generally lower speed and less reliable than the Primary Controlling LAN.
Server	A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.
Standardized Query Language	SQL - A standardized means for requesting information from a database.
Supervisory LAN	Ethernet-based LAN connecting Primary Controller LANs with each other and OWSs, CSS, and THS. See System Architecture below.
Supply	Purchase, procure, acquire and deliver complete with related accessories
Wiring	Raceway, fittings, wire, boxes and related items
Work	Labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation

1.5 QUALITY ASSURANCE

A. Materials and Equipment

1. Manufacturer's Qualifications: See 2.01 for approved manufacturers.
2. Product Line Demonstrated History: The direct digital control equipment product line being proposed for the Project must have an installed history of demonstrated satisfactory operation for a length of one year since date of final completion in at least 10 installations of comparative size and complexity.
3. All products used in this Project installation shall be new, currently under manufacture, and shall have been available from the manufacturer for a minimum of 6 months prior to date of proposal and previously installed and proven effective

in installations of similar nature, not including test sites. This installation shall not be used as a test site for any new products unless explicitly approved by the University in writing. Spare parts shall be available for at least five years after completion of this contract.

4. All BACnet devices must either be certified as compliant with the BACnet standard through a listing by the BACnet Testing Laboratory (BTL) or the vendor must supply proof of having submitted the device for testing by BTL.
5. The EMCS and components shall be listed by Underwriters Laboratories UL 916 as an Energy Management System.

B. Installer

1. EMCS Contractor's Project Manager Qualifications: Individual shall specialize in and be experienced with direct digital control system installation for not less than 3 years. Project Manager shall have experience with the installation of the proposed direct digital control equipment product line for not less than 2 projects of similar size and complexity. Project Manager must have proof of having successfully completed the most advanced training offered by the manufacturer of the proposed product line.
2. EMCS Contractor's Programmer Qualifications: Individual(s) shall specialize in and be experienced with direct digital control system programming for not less than 3 years and with the proposed direct digital control equipment product line for not less than 1.5 years. Programmers must show proof of having successfully completed the most advanced programming training offered by the vendor of the programming application on the proposed product line.
3. EMCS Contractor's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. EMCS Contractor must document a minimum 5-year history of servicing installations of similar size and complexity. Installer must also document at least a 1-year history of servicing the proposed product line.
4. Installer's Response Time and Proximity
 - a. Installer must maintain a fully capable service facility within 100 miles of the subject Project. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.
 - b. Installer must demonstrate the ability to meet the emergency response times listed in paragraph 1.11B.1.
5. Electrical installation shall be by manufacturer-trained electricians.
 - a. Exception: Roughing in wiring and conduit and mounting panels may be subcontracted to any licensed electrician.

1.6 SUBMITTALS

- A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformity with the design intent and the Contractor has responded to all comments to the satisfaction of the University's Representative.
- B. Submit drawings and product data as hereinafter specified. Conditions in this Section take precedence over conditions in Division 1 or Section 23 05 00 Basic Mechanical Materials and Methods.

- C. Submittal Schedule: Submittal schedule shall be as follows unless otherwise directed by the University's Representative:
1. Allow 10 working days for approval, unless University's Representative agrees to accelerated schedule.
 2. Submittal Package 0 (Qualifications) shall be submitted with bid.
 3. Submittal Package 1 (Hardware and Shop Drawings) shall be submitted in accordance with schedule established by the University in bid documents.
 4. Submittal Package 2 (Programming and Graphics) and shall be submitted no less than 30 days before software is to be installed in field devices.
 5. Submittal Package 5 (Post-Construction Trend Logs) shall be submitted in accordance with schedule established by the University in bid documents.
 6. Submittal Package 6 (End-of-Warranty Trend Logs) shall be submitted in accordance with schedule established by the University in bid documents.
- D. Submission and Resubmission Procedure
1. Each submittal shall have a unique serial number that includes the associated specification section followed by a number for each sub-part of the submittal for that specification section, such as SUBMITTAL 230900-01
 2. Each resubmittal shall have a the original unique serial number plus unique revision number such as SUBMITTAL 230900-01 REVISION 1
 3. Submit one copy of submittal in electronic format specified under each submittal package below. Submissions made in the wrong format will be returned without action.
 4. University's Representative will return a memo or mark-up of submittal with comments and corrections noted where required.
 5. Make corrections
 - a. Revise initial submittal to resolve review comments and corrections.
 - b. Indicate any changes that have been made other than those requested.
 - c. Clearly identify resubmittal by original submittal number and revision number.
 6. Resubmit revised submittals until no exceptions are taken.
 7. Once submittals are accepted with no exceptions taken, make photocopies for coordination with other trades. Photocopies will serve as submittal for record and coordination.
- E. Submittals Packages
1. Submittal Package 1 (Hardware and Shop Drawings)
 - a. Hardware
 - 1) Organize by specification section and device tags as tagged in these specifications.
 - 2) Do not submit products that are not used even if included in specifications.
 - 3) Include a summary table of contents listing for every submitted device:
 - a) Tab of submittal file/binder where submittal is located
 - b) Device tag as tagged in these specifications (such as TS-1A, FM-1)
 - c) Specification section number (down to the lowest applicable heading number)
 - d) Whether device is per specifications and a listed product or a substitution

- e) Manufacturer
- f) Model number
- g) Device accuracy (where applicable)
- h) Accuracy as installed including wiring and A/D conversion effects (where applicable)
- 4) Submittal shall include manufacturer's description and technical data, such as performance data and accuracy, product specification sheets, and installation instructions for all control devices and software.
- 5) When manufacturer's cut-sheets apply to a product series rather than a specific product, the data specifically applicable to the Project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.
- 6) Format: Word-searchable format per Paragraph 1.07C.2.
- b. Shop Drawings
 - 1) System architecture one-line diagram indicating schematic location of all control units, workstations, LAN interface devices, gateways, etc. Indicate address and type for each control unit. Indicate media, protocol, baud rate, and type of each LAN.
 - 2) Label each input and output with the appropriate range.
 - 3) Device table (Bill of Materials). With each schematic, provide a table of all materials and equipment including.
 - a) Device tag as indicated in the schematic and actual field labeling (use tag as indicated in these specifications where applicable and practical)
 - b) Device tag as indicated in these specifications where applicable and if it differs from schematic device tag
 - c) Description
 - d) Proposed manufacturer and model number
 - e) Range
 - f) Quantity
 - 4) Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
 - 5) Details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.
 - 6) Scale plan view drawings shall show the specific location of all control devices such as sensors, panels, etc.
 - 7) Format
 - a) Sheets shall be consecutively numbered.
 - b) Each sheet shall have a title indicating the type of information included and the mechanical/electrical system controlled.
 - c) Table of Contents listing sheet titles and sheet numbers.
 - d) Legend and list of abbreviations.

- e) Electronic format per Paragraph 1.07C.2.
- c. Do not include sequence of controls on shop drawings or equipment submittals; they are included in Submittal Package 2.
- d. Submit along with shop drawings but under separate cover memory allocation projections and calculated and guaranteed system response times of the most heavily loaded LAN in the system.
- 2. Submittal Package 2 (Programming and Graphics)
 - a. A detailed description of point naming convention conforming to Paragraph 3.12A to be used for all software and hardware points, integrated with existing database convention.
 - b. A list of all hardware and software points identifying their full text names, device addresses and descriptions.
 - c. Control Logic Documentation
 - 1) Submit control logic program listings (graphical programming) consistent with specified English-language Sequences of Operation for all control units.
 - 2) Control logic shall be annotated to describe how it accomplishes the sequence of operation. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.
 - 3) Include specified English-language Sequences of Operation of each control sequence updated to reflect any suggested changes made by the Contractor to clarify or improve the sequences. Changes shall be clearly marked. SOO shall be fully consistent with the graphical programming.
 - 4) Include control settings, setpoints, throttling ranges, reset schedules, adjustable parameters and limits.
 - 5) Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation.
 - d. Graphic screens of all required graphics, provided in final colors.

1.7 COMPLETION REQUIREMENTS

A. Procedure

- 1. Until the documents required in this Section are submitted and approved, the system will not be considered accepted and final payment to Contractor will not be made.
- 2. Before requesting acceptance of Work, submit one set of completion documents for review and approval of University.
- 3. After review, furnish quantity of sets indicated below to University.

B. Completion Documents

- a. As-built versions of the submittal product data. Submittal data shall be located in tabs along with associated maintenance information.
- b. Complete original issue documentation, installation, and maintenance information for all third-party hardware and software provided, including computer equipment and sensors.
- c. A list of recommended spare parts with part numbers and suppliers.

- d. English language control sequences updated to reflect final programming installed in the EMCS at the time of system acceptance.
 - e. A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface.
 2. Commissioning Reports. Completed versions of all Pre-functional, Functional, and Demonstration Commissioning Test reports, calibration logs, etc., per Paragraph 3.15B.
 3. Copy of inspection certificates provided by the local code authorities.
 4. Written guarantee and warranty documents for all equipment and systems, including the start and end date for each.
 - C. Format of Completion Documents
 1. Provide the type and quantity of media listed in table below.
 2. Where electronic copies are specified, comply with the following:
 - a. Provide in word-searchable electronic format; acceptable formats are MS Word, Adobe Acrobat (pdf), and HTML; submit other formats for review and approval prior to submission; scanned paper documents not acceptable
 - b. For submittals, provide separate file for each type of equipment.
 - c. Record drawings shall be in original format per Paragraph 1.06F.
 - d. Control sequences shall be in MS Word.
 - D. Permanent On-site Documentation
 1. In panels, provide point list of all points in panel in sufficiently permanent manner that list cannot be easily removed (and lost).
- 1.8 EMCS DESIGN
- A. SYSTEM ARCHITECTURE
 1. General
 - a. The system provided shall incorporate hardware resources sufficient to meet the functional requirements specified in this Section. Include all items not specifically itemized in this Section that are necessary to implement, maintain, and operate the system in compliance with the functional intent of this Section.
 - b. The existing Campus EMCS consists of a control system server interconnected by a high speed Supervisory LAN to each campus building and facility. This project includes integrating building level BCs and other control devices into the campus system.
 - c. All control products provided for this Project shall comprise an interoperable Native BACnet System operating over a dedicated Primary Controlling LAN. All control products provided for this Project shall conform to ANSI/ASHRAE Standard 135.
 2. Operator Interfaces and Servers. The Control Systems Server (CSS) and Operator interface devices are existing. No additional CSS, OWS, or POT shall be provided as a part of this project.
 3. Controllers. The BCs, AACs, and ASCs shall monitor, control, and provide the field interface for all points specified.
 4. Gateways

- a. Gateways shall be provided only as required for non-BACnet compatible devices such as:
 - 1) Lighting Controls
 - b. Where gateways are indicated, some devices or systems might already have a gateway provided with the equipment or have direct communication capability without a gateway. In this case, a gateway is not required by this Section.
 - c. It is this Section's responsibility to determine and carry out the communication protocols, obtaining IP addresses, create subnets, provide miscellaneous wiring and hardware, produce connectivity, programming, , etc. required.
 - d. Meet with each party (University, manufacturer's representative, etc.) as required to obtain the needed information.
 - e. Where setpoints are required for the operation of the system (such as time scheduling for the lighting control system, units of measurement or display, etc.), establish the required information and input the required data and parameters.
5. Sensor selection, wiring method, use of transmitters, A-to-D conversion bits, etc. shall be selected and adjusted to provide end-to-end (fluid to display) accuracy at or better than those listed in the following table.

Measured Variable	Reported Accuracy
Space drybulb temperature	±1°F
Ducted Air drybulb temperature	±0.5°F
Mixed Air drybulb temperature	±1°F
Outside Air drybulb temperature	±0.5°F
Relative Humidity – general	±5% RH
Relative Humidity – outdoor air	±3% RH
Airflow (terminal)	±10% of reading
Airflow (measuring stations)	±5% of full scale
Air Pressure (ducts)	±0.05 inches
Air Pressure (space)	±0.01 inches
Carbon Dioxide (CO ₂)	±75 ppm

1.9 UNIVERSITY OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project-developed software and documentation shall become the property of the University. These include, but are not limited to
 1. Project graphic images
 2. Record drawings
 3. Project database
 4. Project-specific application programming code
 5. All documentation

1.10 WARRANTY

- A. At the successful completion of the final testing, commissioning, and demonstration phase in accordance with the terms of this specification, if equipment and systems are operating satisfactorily to the University and if all completion requirements per paragraph 1.7B have been fulfilled, the University shall certify in writing that the control system has been accepted. The date of acceptance shall be the start of the warranty period.
- B. Guarantee all materials, equipment, apparatus and workmanship (including programming) to be free of defective materials and faulty workmanship for period of one year from date of acceptance.
- C. Valve and damper actuators shall carry a manufacturer's 5-year warranty.
- D. Provide new materials, equipment, apparatus and labor to replace that determined by University to be defective or faulty.
- E. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the University. Contractor shall respond to the University's request for warranty service within 24 hours during normal business hours.
- F. Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies shall be provided at no cost to the University during the warranty period.
- G. Sequence of operation programming bugs (both due to programming misinterpretations and sequence errors) shall be corrected and any reasonable control sequence changes required to provide proper system operation shall be provided at no additional cost to the University during this period.

1.11 WARRANTY MAINTENANCE

- A. The University reserves the right to make changes to the EMCS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the University, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the EMCS.
- B. At no cost to the University, provide maintenance services for software and hardware components during the warranty period as specified below:
 - 1. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the University to the Contractor.
 - a. Response by telephone or via internet connection to the EMCS to any request for service shall be provided within two hours of the University's initial request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected, at least one technician, trained in the system to be serviced, shall be dispatched to

- the University's site within eight hours of the University's initial request for such services.
2. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following notification by the University to the Contractor.
 - a. Response by telephone to any request for service shall be provided within eight working hours (contractor specified 40 hr per week normal working period) of the University's initial request for service.
 - b. In the event that the malfunction, failure, or defect is not, at least one technician, trained in the system to be serviced, shall be dispatched to the University's site within three working days of the University's initial request for such services, as specified.
 3. University's Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for University to call in the event of a need for service. At least one of the lines shall be attended continuously (24/7). Alternatively, pagers can be used for technicians trained in system to be serviced. One of the three paged technicians shall respond to every call within 15 minutes.
 4. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.
 5. Documentation: Record drawings and software documentation shall be updated as required to reflect any and all changes made to the system or programming during the warranty period.

PART 2 - PRODUCTS

1.12 PRIMARY EMCS MANUFACTURER

- A. Automated Logic Inc. to match University standard and existing building design; no substitutions accepted.

1.13 GENERAL

- A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way.
- B. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer

1.14 CONTROLLERS

- A. Building Controller (BC)
 1. ALC ME-series
- B. Advanced Application Specific Controller (AAC)
 1. ALC SE-series
- C. Application Specific Controller (ASC)

1. ALC ZN-series
- 1.15 COMMUNICATION DEVICES
- A. Supervisory LAN Routers
 1. ALC LGR line
- 1.16 EMCS INTERFACE HARDWARE
- A. Not Used. No new CSS, OWS, or POT are required for this project.
- 1.17 CONTROL AIR TUBING FOR DUCT PRESSURE SENSORS AND VELOCITY PRESSURE PROBES
- A. Seamless copper tubing, Type L-ACR, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder-joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder.
 - B. Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, and with flame-retardant harness for multiple tubing. Use compression or push-on brass fittings.
- 1.18 ELECTRIC WIRING AND DEVICES
- A. All electrical work shall comply with Division 26.
 - B. Communication Wiring
 1. Provide all communication wiring between Building Controllers, Routers, Gateways, AACs, ASCs and local and remote peripherals (such as operator workstations, printers, and modems).
 2. Supervisory LAN: For any portions of this network required under this section of the specification, contractor shall use Fiber or Category 5 of standard TIA/EIA 68 (10baseT). Network shall be run with no splices and separate from any wiring over 30 volts.
 3. Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over 30 volts. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.
 - C. Analog Signal Wiring
 1. Input and output signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, current or voltage analog outputs, etc. shall be twisted pair, 100% shielded if recommended or required by controller manufacturer, with PVC cover. Gauge shall be as recommended by controller manufacturer.

1.19 CONTROL CABINETS

- A. All control cabinets shall be fully enclosed with hinged door, key-lock latch. A single key shall be common to all field panels and sub-panels within each building. Provide 3 keys.
- B. Construction
 - 1. Indoor: NEMA 1
 - 2. Outdoor: NEMA 4
- C. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs or tie-wrapped. Terminals for field connections shall be UL Listed for service, individually identified per control-interlock drawings, with adequate clearance for field wiring. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover. Control terminations for field connection shall be individually identified per control Shop Drawings.
- D. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

1.20 SENSORS AND MISCELLANEOUS FIELD DEVICES

- A. The listing of several sensors or devices in this section does not imply that any may be used. Refer to points list in Paragraph 2.14 Points List for device specification. Only where two or more devices are specifically listed in points list (such as "FM-1 or FM-4") may the Contractor choose among listed products.
- B. Actuators
 - 1. Manufacturers
 - a. Belimo
 - b. Automated Logic Control
 - c. Siemens
 - d. Johnson Controls
 - e. Delta
 - f. Invensys
 - g. Or equal
 - 2. Warranty: Valve and damper actuators shall carry a manufacturer's 5-year warranty.
 - 3. Electric Actuators
 - a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.
 - b. Dampers. The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The clamp shall be steel of a V-bolt design with associated V-shaped, toothed cradle attaching to the shaft for maximum strength and eliminating slippage via cold weld attachment. Single bolt or set screw type fasteners are not acceptable. Aluminum clamps are unacceptable.
 - c. Valves. Actuators shall be specifically designed for integral mounting to valves without external couplings.

- d. Actuator shall have microprocessor based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible. +++
 - e. Actuators shall provide protection against actuator burnout using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation or use of magnetic clutches are not acceptable.
 - f. Modulating Actuators
 - 1) General: Actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. Actuators shall have positive positioning circuit so that controlled device is at same position for a given signal regardless of operating differential pressure.
 - 2) Optional for VAV box dampers only: Actuators may be floating type if either feedback from the actuator is provided as an analog input.
 - g. Where indicated on Drawings or Points List, actuators shall provide a 2 to 10 VDC position feedback signal.
 - h. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC. Actuators operating on 120 VAC power shall not require more than 10 VA. Actuators operating on 230 VAC power shall not require more than 11 VA.
 - i. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
 - j. Actuators shall be provided with a conduit fitting an a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
 - k. Where fail-open or fail-closed position is required, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe are not acceptable. All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
 - l. Actuators shall be capable of being mechanically and electrically paralleled to increase torque where required.
 - m. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 inch-pound torque capacity shall have a manual crank for this purpose.
 - n. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed.
 - o. Provide limit (end) position switches where indicated on schematics or points list.
 - p. Actuators shall clearly indicate position of damper/valve.
4. Normal Position. Except as specified otherwise herein, Normal positions of control devices with spring return shall be as indicated in table below. For actuators not indicated as Spring Return Required in the table, non-spring style actuators are acceptable and normal position is not applicable.

Device	Normal Position	Spring Return Required
VAV box dampers	OPEN	

5. Valve Actuator Selection
 - a. Modulating actuators for valves shall have minimum rangeability of 50 to 1.
 - b. Water
 - 1) 2-way and two-position valves
 - a) Tight closing against 125% of system pump shut-off head.
 - b) Modulating duty against 90% of system pump shut-off head.
 - 2) 3-way shall have close-off against twice the full open differential pressure for which they are sized.
6. Damper Actuator Selection
 - a. Actuators shall be direct coupled. For multiple sections, provide one actuator for each section; linking or jack-shafting damper sections shall not be allowed.
 - b. Provide sufficient torque as velocity, static, or side seals require per damper manufacturer's recommendations and the following:
 - 1) Torque shall be a minimum 5 inch-pound per square foot for opposed blade dampers and 7 inch-pound per square foot for parallel blade dampers.
 - 2) The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating.

C. General Field Devices

1. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.
2. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.
3. Field devices specified herein are generally two-wire type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with two-wire type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, provide four-wire type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.
4. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices.
5. Accuracy: As used in this Section, accuracy shall include combined effects of nonlinearity, nonrepeatability and hysteresis. Sensor accuracy shall be at or better than both that specifically listed for a device and as required by Paragraph 1.8B.2.

D. Temperature Sensors (TS)

1. General

- a. Unless otherwise noted, sensors may be platinum RTD, thermistor, or other device that is commonly used for temperature sensing and that meets accuracy, stability, and resolution requirements.
 - b. When matched with A/D converter of BC, AAC, or ASC, sensor range shall provide a resolution of no worse than 0.3°F (0.16 °C) (unless noted otherwise herein).
 - c. Sensors shall drift no more than 0.3°F and shall not require calibration over a five-year period.
 - d. Manufacturers
 - 1) Mamac
 - 2) Kele Associates
 - 3) Building Automation Products Inc.
 - 4) Automated Logic Corp.
 - 5) Or equal
2. Duct temperature sensors: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Sensor probe shall be 304 stainless steel.
- a. TS-1A: Single point (use where not specifically called out to be averaging in points list).
 - b. TS-1B: Averaging. Sensor length shall be at least 1 linear foot for each 3 square feet of face area up to 25 feet maximum.
3. Room Sensors: Shall be an element contained within a ventilated cover, suitable for wall mounting, with insulated base.
- a. TS-3A
 - 1) Thermistor in enclosure with blank cover.
 - 2) For temperature sensors connected to terminal box controllers (such as at VAV boxes) that require calibration: Include a USB port or some other means for connection of POT for terminal box calibration. Alternative means of terminal calibration are acceptable provided they result in no cost to Work performed under Section 230593 Testing, Adjusting, and Balancing.
 - b. TS-3C: Same as TS 3A except:
 - 1) Integral LCD display of space temperature and active setpoint.
 - 2) Setpoints shall be adjustable at wall mounted sensor with setpoint knobs (with software limits and setpoint adjustment capability through the OWS).
 - 3) Override button capable of being programmed to start system during unscheduled hours.
 - c. Unless otherwise indicated in points list, locate sensors as follows:
 - 1) Lobbies, corridors, break rooms, and public spaces: TS-3A
 - 2) Back-of-house spaces: TS-3A
 - 3) Open offices: TS-3A
 - 4) Private offices without VAV diffusers: TS-3C
 - 5) Private office with VAV diffusers: TS-3D (wireless)
 - 6) Conference rooms, meeting rooms, training rooms, etc.: TS-3C
 - 7) Others not listed: Confirm with Engineer through RFI.

E. Differential Pressure Transmitters (DP)

1. DPT-4: VAV Velocity Pressure

- a. General: Loop powered two-wire differential capacitance cell type transmitter
 - b. Output: Two-wire, 4-20 mA output with zero adjustment
 - c. Flow transducer (including impact of A-to-D conversion) shall be capable of stably controlling to a setpoint of 0.004 inches differential pressure or lower, shall be capable of sensing 0.002 inches differential pressure or lower, and shall have a ± 0.001 inches or lower resolution across the entire scale.
 - d. Minimum Range: 0 in. water column
 - e. Maximum Range: 1.5 inch water column
 - f. Housing: Polymer housing suitable for surface mounting
 - g. Manufacturer
 - 1) Automated Logic [to match University Standard; no substitutions accepted.]
- F. Current Switches (CS-1)
1. Clamp-on or solid-core
 2. Range: 1.5 to 150 amps
 3. Trip Point: Adjustable
 4. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage
 5. Lower Frequency Limit: 6 Hz
 6. Trip Indication: LED
 7. Approvals: UL, CSA
 8. May be combined with relay for start/stop
 9. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing with override switch. Kele RIBX, Veris H500, or equal
 10. Manufacturers
 - a. Veris Industries H-708/908; Inc.
 - b. RE Technologies SCS1150A-LED
 - c. Or equal
- G. CO₂ Sensors/Transmitters (CO₂)
1. CO₂-1: Wall mounted.
 - a. Non-dispersive infrared sensor with dual beam technology where a reference channel is used to maintain sensor calibration
 - b. Detachable base with all field wiring terminations on base
 - c. Accuracy: ± 60 ppm or 5% of reading from 0 to 1500 ppm at temperatures from 60°F to 90°F
 - d. Factory calibrated and set to 0-2000 ppm range (equals 4-20 mA or 0-10 V)
 - e. Include elevation adjustment
 - f. The sensor shall not require recalibration for a minimum of 5 years, guaranteed. If sensor is found to be out of calibration, supplier shall recalibrate at no additional cost to the University within 5 years of purchase date.
 - g. No display
 - h. Manufacturers
 - 1) Telaire 8101
 - 2) AirTest EE80-2CT
 - 3) Or equal
 - 2.

3. CO2-2: Same as CO2-1 except duct mounted

1.21 CALIBRATION & TESTING INSTRUMENTATION

- A. Provide instrumentation required to verify readings, calibrate sensors, and test the system and equipment performance.
- B. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6-month period. Certificates of calibration shall be submitted.
- C. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (for example if field device is $\pm 0.5\%$ accurate, test equipment shall be $\pm 0.25\%$ accurate over same range).

1.22 SOFTWARE

- A. General
 1. System software shall be based on the latest version ALC WebCTRL server/thin-client architecture. Servers shall be accessed using a web browser over the control system Supervisory LAN, the University's IT LAN, and remotely over the Internet (through the University's IT LAN).
 2. Furnish and install all software and programming necessary to provide a complete and functioning system as specified. Include all software and programming not specifically itemized in these specifications that is necessary to implement, maintain, operate, and diagnose the system in compliance with these specifications.
- B. Licensing
 1. Include licensing and hardware keys for all software packages at all workstations (OWSs and POTs) and servers.
 2. Within the limitations of the server, provide licenses for any number of users shall have web access to the CSS at any given time.
 3. All operator interface, programming environment, networking, database management and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the University.
 4. All operator software, including that for programming and configuration, shall be available on all workstations. Hardware and software keys to provide all rights shall be installed on all workstations.
- C. Graphical User Interface Software
 1. Latest version of WebCTRL matching existing building configuration.
 - a. The GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated graphics and active setpoint graphic controls shall be used to enhance usability.
 - b. Graphics tools used to create Web Browser graphics shall be non-proprietary and provided and installed on each OWS.

- c. Point Override Feature
 - 1) Every real output or virtual point displayed on a graphic shall be capable of being overridden by the user (subject to security level access) by mouse point-and-click from the graphic without having to open another program or view.
 - 2) When the point is selected to be commanded
 - a) Dialog box opens to allow user to override the point (Operator Mode) or release the point (Automatic Mode). Operator Mode will override automatic control of the point from normal control programs.
 - b) Dialog box shall have buttons (for digital points) or a text box or slide bar (for analog points) to allow user to set the point's value when in operator mode. These are grayed out when in automatic mode.
 - c) When dialog box is closed, mode and value are sent to controller.
 - d) Graphic is updated upon next upload scan of the actual point value.
 - 3) A list of points that are currently in an operator mode shall be available through menu selection.
 - d. Point override status (if a digital point is overridden by the supervised manual override per Paragraph 2.3A or if a point is in operator mode per Paragraph 2.13C.2.d) shall be clearly displayed on graphics for each point, such as by changing color or flag.
 - e. The color of symbols representing equipment shall be able to change color or become animated based on status of binary point to graphically represent on/off status.
 - f. On floor plan displays of spaces, temperature shall be graphically displayed by coloring the zone area using standard ALC color coding.
2. Alarms
- a. Standard ALC WebCTRL alarm package configured as indicated below.
 - b. All alarms are assigned a category of HVAC, Plumbing, Electrical, Fire and a Level of 1, 2, or 3, as designated in the Sequence of Controls.
 - c. Alarms in ALC require configuration related to criticality (Critical/Not Critical), operator acknowledgement (Requires Acknowledgement/Does Not Require Acknowledgement), and conditions required for an alarm to clear automatically (Requires a Return to Normal/Requires Acknowledgement of a Return to Normal). These configurations are to be made by level as follows:

	Level 1	Level 2	Level 3
Critical	Y	N	N
Not Critical	N	Y	Y
Requires Acknowledgement	Y	Y	N
Does Not Require Acknowledgement	N	N	Y

Requires a Return to Normal	Y	N	N
Require Acknowledgement of a Return to Normal	N	N	N

3. Trends
 - a. Standard ALC WebCTRL trend package configured as indicated below.
 - b. Trend Data Storage
 - 1) The database shall allow applications to access the data while the database is running. The database shall not require shutting down in order to provide read-write access to the data. Data shall be able to be read from the database without interrupting the continuous storage of trend data being carried by the EMCS.
 - 2) Data shall be stored in MySQL database format.
 - 3) Database shall be available through the University's intranet and/or internet (with appropriate security clearance).
 4. Security
 - a. Standard ALC WebCTRL security package.
- D. Control Programming Software
1. Standard ALC WebCTRL Eikon programming.

1.23 CONTROL POINTS

- A. Table Column Definitions
1. Point description
 2. Type (number in point schedule after each type refers to tag on schematics)
 - a. AO: analog output
 - b. AI: analog input
 - c. DO: digital or binary output
 - d. DI: digital or binary input
 3. Device description
 - a. See Paragraph 2.6 for device definition.
 4. Trend Logging
 - a. Commissioning (Cx): Where listed, point is to be trended at the basis listed for commissioning and performance verification purposes.
 - b. Continuous (Cont): Where listed, point is to be trended at the basis listed continuously, initiated after system acceptance, for the purpose of future diagnostics.
 - c. Trend Basis
 - 1) Where range of engineering units is listed, trend on a change of value (COV) basis (in other words record time stamp and value when point value changes by engineering unit listed)
 - 2) Where time interval is listed, trend on a time basis (in other words record time stamp and value at interval listed). All points relating to a specific piece of equipment shall be trended at the same initiation time of day so data can be compared in text format.
 5. Calibration (Calib)
 - a. F = factory calibration only is required (no field calibration)

- b. HH = field calibrate with handheld device. See Paragraph 2.10
- c. DB = field calibrate with a drywell bath. See Paragraph 2.10

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details indicated on Drawings.
- B. Coordinate Work and Work schedule with other trades prior to construction.
- C. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment.
- B. Store equipment and materials inside and protect from weather.

3.3 IDENTIFICATION

- A. General
 - 1. Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.
 - 2. Identifiers shall match record documents.
 - 3. All plug-in components shall be labeled such that removal of the component does not remove the label.
- B. Wiring and Tubing
 - 1. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2 inches of termination with the EMCS address or termination number.
 - 2. Permanently label or code each point of field terminal strips to show the instrument or item served.
 - 3. All pneumatic tubing shall be labeled at each end within 2 inches of termination with a descriptive identifier.
- C. Equipment and Devices
 - 1. Identify room sensors relating to terminal box or valves with indelible marker on sensor hidden by cover.

3.4 CLEANING

- A. Clean up all debris resulting from its activities daily. Remove all cartons, containers, crates, and other debris generated by Work in this Section as soon as their contents have been removed. Waste shall be collected and legally disposed of.
- B. Materials stored on-site shall be protected from weather and stored in an orderly manner, neatly stacked, or piled in the designated area assigned by the University's Representative.
- C. At the completion of work in any area, clean all work and equipment of dust, dirt, and debris.
- D. Use only cleaning materials recommended by the manufacturer of the surfaces to be cleaned and on surfaces recommended by the cleaning material manufacturer.

3.5 CONTROLLERS

- A. General
 - 1. Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details indicated on Drawings.

3.6 COMMUNICATION DEVICES

- A. General
 - 1. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details indicated on Drawings.
 - 2. Provide all interface devices and software to provide an integrated system.
- B. LANID and LAN Routers
 - 1. Provide as required
 - 2. Connect Supervisory LAN to dedicated control system fiber optic cable via 100Base-T to 100/1000Base-SX/LX fiber media converter (supplied by University) installed in a rack mounted in main telecom room.
 - 3. Connect networks to both sides of device
 - 4. Thoroughly test to ensure proper operation
 - 5. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted. The system shall automatically monitor the operation of all network devices and annunciate any device that goes off-line because it is failing to communicate.

3.7 CONTROL AIR TUBING

- A. Sensor air tubing shall be sized by the Contractor.
- B. All control air piping shall be concealed except in equipment rooms or unfinished areas.

- C. Installation methods and materials
 - 1. Concealed and Inaccessible: Use copper tubing or FR plastic in metal raceway. Room thermostat drops in stud walls in areas with lay-in ceiling may be FR plastic tubing.
 - 2. Concealed and Accessible tubing (including ceiling return air plenums) shall be copper tubing or FR plastic tubing, subject to the following limitations
 - a. FR tubing shall be enclosed in metal raceway when required by local code.
 - b. Quantity of FR tubing per cubic foot of plenum space shall not exceed manufacturer's published data for Class 1 installation.
 - 3. Exposed to view or damage: Use hard-drawn copper or FR plastic in metal raceway.
 - a. Where copper tubing is used, a section 12 inches or less of FR plastic tubing is acceptable at final connection to control device.
 - D. Mechanically attach tubing to supporting surfaces. Sleeve through concrete surfaces in minimum 1 inch sleeves, extended 6 inches above floors and 1 inch below bottom surface of slabs.
 - E. Pneumatic tubing shall not be run in raceway containing electrical wiring.
 - F. Where FR tubing exits the end of raceway or junction box, provide a snap-in nylon bushing. Where pneumatic tubing exits control panels, provide bulkhead fittings. Where copper tubing exits junction boxes or panels, provide bulkhead fittings.
 - G. All tubing shall be number coded on each end and at each junction for easy identification.
 - H. All control air piping shall be installed in a neat and workmanlike manner parallel to building lines with adequate support.
 - I. Piping above suspended ceilings shall be supported from or anchored to structural members or other piping or duct supports. Tubing shall not be supported by or anchored to electrical raceways or ceiling support systems.
 - J. Brass-barbed fittings shall be used at copper-to-FR tubing junctions. Plastic slipped-over copper tubing is not acceptable.
 - K. Number-code or color-code tubing, except local individual room control tubing, for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.
- 3.8 CONTROL POWER
- A. Power wiring and wiring connections required for Work in this Section shall be provided under this Section unless specifically indicated on Division 23 Drawings or Specifications. See Paragraph 1.2C.
 - B. Unless transformers are provided with equipment as specified in related Division 23 and 26 equipment Sections, Contractor shall provide transformers for all low voltage control devices including non-powered terminal units such as cooling-only VAV boxes and VAV

boxes with hot water reheat. Transformer(s) shall be located in control panels in readily accessible locations such as Electrical Rooms.

- C. Power line filtering. Provide transient voltage and surge suppression for all workstations and BCs either internally or as an external component.

3.9 CONTROL AND COMMUNICATION WIRING

A. Control and Signal Wiring

1. Comply with Division 23.
2. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC requirements and shall be installed by a licensed electrician.
3. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.) Class 2 wiring shall be installed in UL Listed approved raceway, except where wires are in concealed in accessible locations, approved cables not in raceway may be used, provided that cables are UL Listed for the intended application. For example, cables used in ceiling return plenums shall be UL Listed specifically for that purpose.
4. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (for example relays and transformers).
5. Do not install wiring in raceway containing tubing.
6. Where Class 2 wiring is used without raceway, it shall be supported from or anchored to structural members neatly tied at 10 foot intervals and at least 1 foot above ceiling tiles and light fixtures. Support or anchoring from straps or rods that support ductwork or piping is also acceptable provided wiring is not in contact with ductwork or piping. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
7. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
8. All field wiring shall be properly labeled at each end, with self-laminating typed labels indicating device address, for easy reference to the identification schematic. All power wiring shall be neatly labeled to indicate service, voltage, and breaker source.
9. Use coded conductors throughout with different colored conductors.
10. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
11. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the Contractor shall provide step-down transformers.
12. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
13. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
14. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendation and NEC requirements.
15. Include one pull string in each raceway 1 inch or larger.

16. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
17. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 inches from high-temperature equipment (for example steam pipes or flues).
18. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
19. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
20. Terminate all control or interlock wiring.
21. Maintain updated as-built wiring diagrams with terminations identified at the jobsite.
22. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than ½ inches electrical trade size shall not be used. In areas exposed to moisture liquid-tight, flexible metal raceways shall be used.
23. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings per code. Terminations must be made with fittings at boxes and ends not terminating in boxes shall have bushings installed.
24. Wire digital outputs to either the normally-closed or normally-open contacts of binary output depending on desired action in case of system failure. Unless otherwise indicated herein, wire to the NO contact except the following shall be wired to the NC contact
25. Hardwire Interlocks
 - a. The devices referenced in this Section are hardwire interlocked to ensure equipment shutdown occurs even if control systems are down. Do not use software (alone) for these interlocks.
 - b. Hardwire device NC contact to air handler fan starter upstream of HOA switch, or to VFD enable contact.
 - c. Where multiple fans (or EMCS DI) are controlled off of one device and the device does not have sufficient contacts, provide a relay at the device to provide the required number of contacts.
 - d. Provide for the following devices where indicated on Drawings or in Sequences of Operation:
 - 1) Duct smoke detector
 - 2) High discharge static pressure
 - 3) Low mixing plenum pressure
 - 4) Freeze-stats
26. Shielded cable shield shall be grounded only at one end. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

B. Communication Wiring

1. Adhere to the requirements of Paragraph 3.10A in addition to this Paragraph.
2. Communication and signal wiring may be run without conduit in concealed, accessible locations as permitted by Paragraph 3.11A only if noise immunity is

ensured. Contractor is fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance.

3. All cabling shall be installed in a neat and workmanlike manner. Follow all manufacturers' installation recommendations for all communication cabling.
4. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
5. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.
6. Verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
7. All runs of communication wiring shall be unspliced length when that length is commercially available.
8. All communication wiring shall be labeled to indicate origination and destination data.
9. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communications Circuits, Cable and Protector Grounding.
10. Power-line carrier signal communication or transmission is not acceptable.

3.10 SENSORS AND MISCELLANEOUS FIELD DEVICES

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for the environment within which the sensor operates.
- C. Temperature Sensors
 1. Room temperature sensors and thermostats shall be installed on concealed junction boxes properly supported by the wall framing.
 - a. For sensors mounted in exterior walls or columns, seal all junction box openings with mastic sealant and pack junction box with fiberglass insulation.
 2. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
 3. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip. Where located in front of filters (such as mixed air sensors), access for filter removal shall be maintained.
 4. For sensors specified to be calibrated using a dry well bath (see points list), install sensors with a sufficient wiring/flexible conduit lead that sensor may be removed from well or duct and placed in an ice bath or dry well for calibration. The spare wiring/flexible conduit shall be no less than 3 feet in length.
 5. All pipe-mounted temperature sensors shall be installed in wells. For small piping, well shall be installed in an elbow into pipe length. Install the sensor in the well with a thermal-conducting grease or mastic. Use a closed-cell insulation patch that is integrated into the pipe insulation system to isolate the top of the well from ambient conditions but allow easy access to the sensor. Install a test plug adjacent to all wells for testing and calibration.
 6. Unless otherwise noted on Drawings or Points List, temperature sensors/thermostats, humidity sensors/humidistats, CO₂ sensors, and other room wall mounted sensors shall be installed at same centerline as adjacent electrical

- switches, 4 feet above the finished floor where there are no adjacent electrical switches, and within ADA limitations.
7. Unless otherwise noted on Drawings or Points List, install outdoor air temperature sensors on north wall where they will not be influenced by building exhaust, exfiltration, or solar insolation. Do not install near intake or exhaust air louvers.
- D. Flow Switches: Install in a straight run of pipe at least 10 diameters in length to minimize false indications.
- E. Airflow Measuring Stations: Install per manufacturer's recommendations in an unobstructed straight length of duct both upstream and downstream of sensor, except those installations specifically designed for installation in fan inlet. For installations in fan inlets, provide on both inlets of double inlet fans and provide inlet cone adapter as recommended by AFMS manufacturer.
- F. Fluid Flow Sensors: Install per manufacturer's recommendations in an unobstructed straight length of pipe both upstream and downstream of sensor.
- G. Actuators
1. Type: All actuators shall be electric.
 2. Mount and link control damper actuators per manufacturer's instructions.
 3. Dampers
 - a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage, or follow manufacturers instructions to achieve same effect.
 - b. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - c. Provide all mounting hardware and linkages for actuator installation.
 4. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible, or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal or down.

3.11 SOFTWARE INSTALLATION

- A. Point Structuring and Naming
1. The intent of this Paragraph is to require a consistent means of naming points across the EMCS. The following requirement establishes a standard for naming points and addressing Buildings, Networks, Devices, Instances, etc.
 2. Point Summary Table
 - a. The term "Point" includes all physical I/O points, virtual points, and all application program parameters.
 - b. With each schematic, provide a Point Summary Table listing
 - 1) Building number and abbreviation
 - 2) System type
 - 3) Equipment type
 - 4) Point suffix

- 5) Full point name (see Point Naming Convention paragraph)
 - 6) Point description
 - 7) Ethernet backbone network number,
 - 8) Network number
 - 9) Device ID
 - 10) Device MAC address
 - 11) Object ID (object type, instance number)
 - 12) Engineering units
 - 13) Device make and model number; include range of device if model number does not so identify
 - 14) Device physical location description; include floor and column line intersection to one decimal place (for example line 6.2 and line A.3)
 - c. Point Summary Table shall be provided in both hard copy and in a relational database electronic format (ODBC-compliant).
 - d. Coordinate with the University's representative and compile and submit a proposed Point Summary Table for review prior to any object programming or Project startup.
 - e. The Point Summary Table shall be kept current throughout the duration of the Project by the Contractor as the Master List of all points for the Project. Project closeout documents shall include an up-to-date accurate Point Summary Table. The Contractor shall deliver to the University the final Point Summary Table prior to final acceptance of the system. The Point Summary Table shall be used as a reference and guide during the commissioning process.
3. Point Naming Convention
- a. All point names shall match the format of similar point names as currently configured in the BAS. Coordinate with university for control points not similarly defined in the project.
- 1)
- B. Point Parameters
1. Provide the following minimum programming for each analog input
 - a. Name
 - b. Address
 - c. Scanning frequency or COV threshold
 - d. Engineering units
 - e. Offset calibration and scaling factor for engineering units
 - f. High and low alarm values and alarm differentials for return to normal condition
 - g. High and low value reporting limits (reasonableness values), which shall prevent control logic from using shorted or open circuit values.
 - h. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the primary or secondary controlling networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides or failure of any network over which the point value is transferred.

- i. Selectable averaging function that shall average the measured value over a user selected number of scans for reporting.
 2. Provide the following minimum programming for each analog output
 - a. Name
 - b. Address
 - c. Output updating frequency
 - d. Engineering units
 - e. Offset calibration and scaling factor for engineering units
 - f. Output Range
 - g. Default value to be used when the normal controlling value is not reporting.
 3. Provide the following minimum programming for each digital input
 - a. Name
 - b. Address
 - c. Engineering units (on/off, open/closed, freeze/normal, etc.)
 - d. Debounce time delay
 - e. Message and alarm reporting as specified
 - f. Reporting of each change of state, and memory storage of the time of the last change of state
 - g. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.
 4. Provide the following minimum programming for each digital output
 - a. Name
 - b. Address
 - c. Output updating frequency
 - d. Engineering units (on/off, open/closed, freeze/normal, etc.)
 - e. Direct or Reverse action selection
 - f. Minimum on-time
 - g. Minimum off-time
 - h. Status association with a DI and failure alarming (as applicable)
 - i. Reporting of each change of state, and memory storage of the time of the last change of state.
 - j. Totalization of on-time (for all motorized equipment status points), and accumulated number of off-to-on transitions.
 - k. Default value to be used when the normal controlling value is not reporting.
- C. Site-Specific Application Programming
 1. All site specific application programming shall be written in a manner that will ensure programming quality and uniformity. Contractor shall ensure:
 - a. Programs are developed by one programmer, or a small group of programmers with rigid programming standards, to ensure a uniform style.
 - b. Programs for like functions are identical, to reduce debugging time and to ease maintainability.
 - c. Programs are thoroughly debugged before they are installed in the field.
 2. Message and tune application programming for a fully functioning system. It is the Contractor's responsibility to request clarification on sequences of operation that require such clarification.
 3. All site-specific programming shall be fully documented and submitted for review and approval
 - a. Prior to downloading into the panel (see Submittal Package 2, Paragraph 1.6.)

- b. At the completion of functional performance testing, and
 - c. At the end of the warranty period (see Warranty Maintenance, Paragraph 1.11).
4. All programming, graphics and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the Project will be the property of the University and shall remain on the workstations/servers at the completion of the Project.

3.12 SEQUENCES OF OPERATION

A. See drawings for specific sequences of operation.

B. General

1. Contractor shall review sequences prior to programming and suggest modifications where required to achieve the design intent. Contractor may also suggest modifications to improve performance and stability or to simplify or reorganize logic in a manner that provides equal or better performance. Proposed changes in sequences shall be included as a part of Submittal Package 2.
2. Include costs for minor program modifications if required to provide stable performance of the system.
3. Unless otherwise indicated in SOOs, control loops shall be enabled and disabled based on the status of the system being controlled to prevent wind-up.
4. The term "PID loop" is used generically for all control loops and shall not be interpreted as requiring proportional plus integral plus derivative gains on all loops. Unless specifically indicated otherwise, the following guidelines shall be followed:
 - a. Use proportional only (P-only) loops for limiting loops (such as zone CO₂ limiting loops, etc.) to ensure there is no integral windup.
 - b. Do not use the derivative term on any loops unless field tuning is not possible without it.
5. All setpoints, timers, deadbands, PID gains, etc. listed in sequences shall be capable of being adjusted by the operator without having to access programming whether indicated as adjustable in sequences or not. Software (virtual) points shall be used for these setpoints. Fixed scalar numbers shall not be imbedded in programs unless the value will never need to be adjusted.
6. Where zone data (such as damper or valve position, control loop signal) is used for reset of the AHU/pump system serving the zone, the zone tag (name) shall be recorded when it is the zone driving the reset (such as the zone requiring the most cooling). This data shall be available for Reports (see Paragraph 2.13C.5) so that zones that are undersized or otherwise driving the system can be identified for remediation if required.

C. Zones

1. Dual Duct VAV Terminal Unit – Snap Acting Control
 - a. Temperature Control Sequence
 - 1) When the zone state is cooling, the cooling-loop output shall reset the cooling supply airflow set point from the minimum to cooling maximum set points. The cooling damper shall be modulated by a control loop to maintain the measured cooling airflow at set point. The heating damper shall be closed.

- 2) When the zone state is deadband, the cooling and heating airflow set points shall be their last set points just before entering deadband. In other words, when going from cooling to deadband, the cooling airflow set point is equal to the zone minimum, and the heating set point is zero. When going from heating to deadband, the heating air- flow set point is equal to the zone minimum, and the cool- ing set point is zero. This results in a snap-action switch in the damper set point as indicated in Figures 5.11.5-1 and 5.11.5-2.
 - 3) When the zone state is heating, the heating-loop output shall reset the heating supply airflow set point from the minimum to heating maximum set points. The heating damper shall be modulated by a control loop to maintain the measured heating airflow at set point. The cooling damper shall be closed.
 - a) If hot-deck supply air temperature from the air handler is less than room temperature, heating supply airflow set point shall be no higher than the minimum.
 - b) If heating air handler is not proven ON, the heating damper shall be closed.
 - c) If cooling air handler is not proven ON, the cooling damper shall be closed.
2. Alarms
- a. Low Airflow
 - 1) If the measured airflow is less than 70% of set point for 5 minutes while set point is greater than zero, generate a Level 3 alarm.
 - 2) If the measured airflow is less than 50% of set point for 5 minutes while set point is greater than zero, generate a Level 2 alarm.
 - 3) If a zone has an Importance-Multiplier of 0 (see Section 5.1.14.2[1][a]) for its static pressure reset T&R control loop, low airflow alarms shall be suppressed for that zone.
 - b. Airflow Calibration Alarm - If the fan serving the zone has been off for 10 minutes, and airflow sensor reading is above 10% of the maximum airflow set point, generate a Level 3 alarm.
 - c. Leaking Damper - If the damper position is 0%, and airflow sensor reading is above 10% of the cooling maxi- mum airflow set point for 10 minutes while the fan serving the damper is proven ON, generate a Level 4 alarm.
3. Testing/Commissioning Overrides. Provide soft- ware switches that interlock to a system level point to
- a. force zone airflow set point to zero,
 - b. force zone airflow set point to Vcool-max,
 - c. force zone airflow set point to Vmin,
 - d. force zone airflow set point to Vheat-max,
 - e. force cooling damper full closed/open,
 - f. force heating damper full closed/open, and
 - g. reset request-hours accumulator point to zero (provide one point for each reset type listed in the next section).
4. System Request
- a. Cooling SAT Reset Requests
 - 1) If the zone temperature exceeds the zone's cooling set point by 3°C (5°F) for 2 minutes and after suppression period due to set point change per Section 5.1.19, send 3 requests.

- 2) Else if the zone temperature exceeds the zone's cooling set point by 2°C (3°F) for 2 minutes and after suppression period due to set point change per Section 5.1.19, send 2 requests.
 - 3) Else if the cooling loop is greater than 95%, send 1 request until the cooling loop is less than 85%.
 - 4) Else if the cooling loop is less than 95%, send 0 requests.
- b. Cold-Duct Static Pressure Reset Requests
- 1) If the measured airflow is less than 50% of set point while set point is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.
 - 2) Else if the measured airflow is less than 70% of set point while set point is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.
 - 3) Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.
 - 4) Else if the damper position is less than 95%, send 0 requests.
- c. Heating SAT Reset Requests
- 1) If the zone temperature is below the zone's heating set point by 3°C (5°F) for 2 minutes and after suppression period due to set point change per Section 5.1.19, send 3 requests.
 - 2) Else if the zone temperature is below the zone's heating set point by 2°C (3°F) for 2 minutes and after suppression period due to set point change per Section 5.1.19, send 2 requests.
 - 3) Else if the heating loop is greater than 95%, send 1 request until the heating loop is less than 85%.
 - 4) Else if the heating loop is less than 95%, send 0 requests
- d. Hot-Duct Static Pressure Reset Requests
- 1) If the measured airflow is less than 50% of set point while set point is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.
 - 2) Else if the measured airflow is less than 70% of set point while set point is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.
 - 3) Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.
 - 4) Else if the damper position is less than 95%, send 0 requests.
- e. Heating-Fan Requests - Send the heating fan that serves the zone a heating-fan request as follows:
- 1) If the heating loop is greater than 15%, send 1 request until the heating loop is less than 1%.
 - 2) Else if the heating loop is less than 15%, send 0 requests.

END OF SECTION

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SECTION 23 30 00
DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Access Doors
 - 2. Balancing Dampers
 - 3. Backdraft Dampers
 - 4. Fire and Smoke Dampers
 - 5. Sound Attenuators
 - 6. Drain Pans
 - 7. Belt Guards
 - 8. All duct accessories except, where integral with manufactured piece of equipment.
- B. Related Sections
 - 1. Section 23 05 00 – Basic Mechanical Materials and Methods

1.2 QUALITY ASSURANCE

- A. Fire, smoke, and fire/smoke dampers shall be UL listed and constructed in accordance with UL Standard 555 Fire Dampers and UL Standard 555S.
- B. Demonstrate operation of smoke dampers to authorities having jurisdiction and University's representative as part of life safety testing.
- C. Access doors shall be UL labeled.
 - 1. Damper pressure drop and leakage ratings shall be based on tests and procedures performed in accordance with AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Access Doors, Ducts
 - 1. Ventfabrics, Inc.
 - 2. Duo Dyne, Corporation

3. Ruskin Mfg. Company
4. PCI Industries – Pottorff
5. Ductmate
6. Or equal

C. Access Doors, Plenum

1. Ventfabrics, Inc.
2. Duo Dyne, Corporation
3. Elgen Manufacturing Company
4. Or equal

D. Multi-blade Volume Dampers

1. Ruskin Manufacturing Company
2. Air Balance Inc.
3. American Warming and Ventilating Inc.
4. Johnson Controls
5. PCI Industries - Pottorff
6. Or equal

E. Multi-blade Volume Dampers

1. Ruskin Manufacturing Company
2. Air Balance Inc.
3. Greenheck
4. PCI Industries - Pottorff
5. Or equal

F. Damper Hardware

1. Ventfabrics, Inc.
2. Duo Dyne, Corporation
3. Young Regulator Company
4. Or equal

G. Combination Fire Damper and Smoke Dampers

1. Ruskin Manufacturing Company
2. Air Balance Inc.
3. PCI Industries - Pottorff
4. Or equal

H. Sound Traps (Attenuators)

1. Vibro-Acoustics
2. Industrial Acoustics, Inc.
3. Gale Noise Control
4. Tempmaster Corporation
5. Environments Elements Corporation, Koppers Company
6. Or equal

2.2 DUCT ACCESS DOORS

- A. In accordance with SMACNA Duct Construction Manuals, except as indicated in the Drawings

- B. In ductwork
 - 1. Construction
 - a. Galvanized steel
 - b. Rating same as duct pressure class
 - c. Where duct is insulated
 - 1) Fiberglass insulation, thickness to match duct insulation installed R-value, see 23 07 00 – Mechanical Insulation
 - 2) Double wall
 - d. Removable type with safety chain linking door permanently to frame
 - e. Positive seal polyethylene gasket
 - f. Paired progressive cam-locks, quantity as required for tight, low leakage fit
 - g. No tools required for opening and closing
 - 2. Size
 - a. 20 inches x 14 inches unless otherwise indicated in the Drawings
 - b. Ducts less than 16 inches: one dimension 20 inches; other dimension 2 inch less than duct width
 - c. Larger sizes where required for access
 - 3. Provide in following locations
 - a. Coils in ducts (including at VAV terminals)
 - 1) Entering side for heating coils
 - b. Automatic dampers: linkage side
 - c. Smoke dampers, fire dampers, and combination fire/smoke dampers.
 - d. Smoke detection heads
 - e. At the top of each lined duct riser accessible from the fan room floor (for inspection of duct liner)
 - f. Fan bearings enclosed in ducts
 - g. Motors, actuators or other accessories that require access or service inside ducts
 - h. Outdoor air plenums as required to clean plenum from dirt and debris.
 - i. Where otherwise indicated on the Drawings

2.3 DAMPERS

- A. Volume Dampers
 - 1. Conform to requirements of SMACNA HVAC Duct Construction Standards.
 - 2. General
 - a. Blades of same material as duct where damper is located
 - b. Damper Hardware
 - 1) Ventlok 400 and 4000 series or equal; for low pressure systems 2 inch SMACNA pressure class and less
 - 2) Ventlok HiVel hardware or equal; for greater than 2 inch SMACNA pressure class
 - c. Actuating quadrants typical for single and multi-blade dampers; provide closed bearing on opposite end from quadrant to prevent air leakage: Ventlok No. 609 or equal
 - d. Bearing at one end of damper rod: Ventlok No. 609 or equal
 - e. Sealed bushings installed at both ends to avoid duct leakage
 - f. Accessible quadrant at other end of damper rod
 - 1) With lever and lock screw: Ventlok No. 635 or equal
 - 2) Insulated ducts

- a) Quadrants mounted on collar to clear insulation
- b) Ventlok Nos. 637, 638, or 639 or equal
- c) Selection based on insulation thickness
- g. For dampers above non-removable ceilings and without ceiling access panels provide Ventlok No. 677 or equal concealed damper regulator
 - 1) With paintable cover plate
 - 2) Required interconnecting hardware
- 3. Single blade dampers
 - a. Galvanized steel ductwork: galvanized steel, except as indicated in the Drawings
 - b. Blade: Two gages heavier than duct gage, or 18 gage, whichever is lighter
- 4. Where access to damper operators on ducts is not possible, provide remote operators, Ventlok #666, Elgen, or equal, with paintable finish steel cover and screws and waterproof gasketing. Cover shall be oversized to lap finished surface 3/8" all around. Provide extended control rods and/or Young #917, Ventlok #680, or equal, miter gears for making right angle turns. Submit samples.
 - a. As an option to the above mechanical remote volume damper operators, the contractor may propose to use remote balancing systems consisting of 9- to 12-volt damper actuator, remote plug-in access port, wiring, and portable 9- to 12-volt hand-held controller. Greenheck, RBD, Young Regulator EBD, or equal.
- B. Automatic Dampers
 - 1. Refer to Section 23 73 27 – Air Handling Units dampers provided with factory packaged air handling equipment.
- C. Backdraft dampers
 - 1. Construction
 - a. Extruded aluminum construction
 - b. Vinyl blade edge seals
 - c. Maximum pressure drop: 0.10 in. w.g.
 - 2. Ruskin Series BD2/A1 or equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades
- B. Install duct accessories in accordance with manufacturer's written installation instructions
- C. See Section 23 31 13 – Ducts
- D. Volume dampers
 - 1. Provide at locations indicated on the Drawings
 - a. Volume dampers shall be installed as far away from air outlets as functionally reasonable to avoid noise in the occupied space.

- b. Provide also in wyes and spin-ins to outlets whether indicated on the Drawings or not, except
 - 1) Where dampers are not indicated on the Drawings above inaccessible ceilings
 - 2) To sidewall outlets in exposed ducts (opposed blade dampers in outlets shall be provided)
 - 2. Additional locations where dampers appear to be required for balancing, place request for information with Engineer prior to construction.
 - 3. For ductwork exposed to occupant view, volume damper handles shall be on top of duct or otherwise concealed from occupant view.
- E. Control dampers
- 1. Field mounted control dampers installed with concealed linkage shaft accessible on side of damper with space for direct-coupled actuator
 - 2. Actuator installation: See Section 23 09 00 – Energy Management & Control Systems
- F. Install belt guards at all exposed belts
- 3.2 SOUND TRAPS (ATTENUATORS)
- A. Install as detailed on the drawings or in accordance with manufacturer's directions.
 - B. Bolt sound traps together as required to form one assembly.
 - C. Install continuous metallic nosing at air inlet side.
 - D. Connect to ductwork with joints specified for the duct pressure class.
 - E. After installation, measure the pressure drop through each soundtrap. If pressure drop exceeds design losses, including accounted-for system effects, replace the soundtraps and/or modify the inlet and/or discharge conditions.
- 3.3 MOUNTING AND ALIGNMENT
- A. Install all accessories to prevent air leakage.
 - B. Install closed bearing end on all damper blades that penetrate duct to prevent air leakage.
 - C. Support extra weight of duct accessories. See Section 23 05 48 – Mechanical Sound, Vibration and Seismic Control
- 3.4 INSPECTION
- A. Verify that adequate clearance between duct accessories and adjacent walls or equipment is available to permit maintenance and repairs.

3.5 PRE-OPERATING CHECKS

- A. Before operating duct accessories: Set all components in normal operating condition

3.6 TESTING AND ADJUSTING

- A. Before operating duct accessories see Section 01 91 00 – Commissioning
- B. Complete the Pre-Functional Checklist, Section 23 97 00 – Mechanical Commissioning, Part 4.
- C. After starting duct accessories
 1. Check for noise and leakage; repair as required at no additional cost to the University
 2. Operation test: Test each piece of equipment to show that it will operate in accordance with requirements.
- D. See Section 23 05 93 – Testing, Adjusting, and Balancing
- E. See Section 23 97 00 – Mechanical Commissioning.

END OF SECTION

SECTION 23 31 13

DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Ductwork
 - 2. Plenums
 - 3. Fasteners and Sealants
 - 4. Exceptions: Where integral with manufactured piece of equipment
- B. Related Sections
 - 1. Section 01 91 00 – Commissioning
 - 2. Section 23 05 00 – Basic Mechanical Materials and Methods

1.2 REFERENCE STANDARDS

- 1. SMACNA HVAC Duct Construction Standards, latest edition

1.3 DEFINITIONS

- A. Seam: locks or weld applied longitudinally to close section of duct, for example longitudinal seam, spiral seam.
- B. Joint: abutting connection between duct sections for continuity of air passage, for example cross joint, transverse joint, coupling.
- C. Reinforcement: hardware applied to strengthen duct, for example girth angles, tie rods, fasteners (not connectors), and the like.
- D. Stiffening: folding, bending, beading, crossbreaking or corrugating of sheets to achieve strength through shape, for example pocket lock secures joint and is transverse stiffener, with girth angle and fasteners applied (not connectors), joint or stiffener is reinforced.
- E. Duct Classification
 - 1. Medium pressure ductwork includes:
 - a. All duct risers enclosed in shafts.
 - b. All exhaust ductwork connected to fans with scheduled static pressure exceeding 2" water column.
 - c. All supply ductwork upstream of VAV and static pressure control terminals or reheat coils.
 - d. Other ductwork noted or specified as medium pressure construction.
 - 2. Low pressure ductwork includes:

- a. All galvanized ductwork downstream of airflow control or VAV and static pressure control terminals and reheat coil, horizontal toilet exhaust duct, and ducts not included under medium pressure ductwork above.
3. Stainless Steel Ductwork: Stainless steel construction conforming to medium pressure standards.
 - a. Shower exhaust from shower to main exhaust duct (where dilution occurs).
4. Duct pressure classification shall be as specified herein and not as recommended in SMACNA publications.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements
 1. Entire ductwork system, including materials and installation, installed in accordance with NFPA 90A
 2. Ductwork and components shall be listed as U.L. 181, 181A and 181B, Class I air duct, flame rating not to exceed 25 and smoke rating not to exceed 50.
- B. Submit a written program outlining protection of ductwork from contamination with dirt and procedures for cleaning contaminated ductwork.
- C. Samples
 1. Internal Duct Liner: Provide a specimen of duct liner, specified in Section 23 07 00 – Mechanical Insulation, mounted on an 8 inches x 8 inches 24 gauge plate indicating method of attachment at edge treatment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. Spiral oval and round ducts
 1. United Sheet Metal Division, United McGill
 2. Semco Manufacturing, Inc.
 3. Metco
 4. Acosta sheet metal
 5. Contractor fabricated
 6. Or equal
- C. Duct Connection Systems
 1. Ductmate Industries, Inc.
 2. Fabriduct Transverse Duct Connection system
 3. Ward Industries, Inc.
 4. Or equal
- D. Flexible Ducts

1. Flexmaster
2. Thermaflex
3. ATCO Rubber Products, Inc.
4. Hart & Cooley
5. Or equal

E. Duct Sealants

1. Minnesota Mining and Manufacturing Company
2. Foster Products Corporation
3. Miracle Adhesive Corporation
4. United Sheet Metal Division United McGill Corporation
5. Hardcast Corporation, Inc.
6. Mon Eco Industries
7. Nashua
8. 3M
9. Or equal

F. Flexible Duct Clamps

1. Panduit
2. Aeroquip Corporation
3. Ideal Division Parker Hannifin Corporation
4. Tridon Corporation
5. Young Regulator Company
6. Or equal

G. Spin-in Fittings

1. Young & Company, Manufacturing
2. Modular Metals
3. Or equal

2.2 MATERIALS

A. Galvanized Steel Sheet Metal

1. Cold rolled soft steel sheets
2. ASTM 526-64T
3. Galvanizing: 1-1/4 ounces per square foot, total both sides
4. Lock-forming quality

B. Miscellaneous Products

1. Screws and rivets
 - a. Same material as sheet, except as indicated on the Drawings
 - b. On aluminum sheets, provide cadmium plated or stainless steel
 - c. Zinc or cadmium plated, permitted on galvanized sheets
 - d. Minimum screw size: No. 10
 - e. Minimum rivet size: 4 pound
2. Duct Sealants
 - a. Sealing compound: Safetee Duct Sealant 32-17, Foster Products Corporation, Design Polymerics DP-1010, or equal
 - b. Tape: Nashua or equal, comply with UL 181B
 - c. Gaskets

- d. Continuous, reinforced, inert self-conforming type
- e. 1/8 inch thick
- f. Width: to match angle connection.
- g. 3M Weatherban Ribbon Sealant PF5422 or equal
3. Hard-setting joint tape, two-part
 - a. Two part tape
 - b. Mineral impregnated woven fiber tape
 - c. Impregnated with activator/adhesive of polyvinyl acetate type
 - d. UL Listed
 - e. Flame spread: 10
 - f. Smoke contributed: 0
 - g. Equal to Hardcast RTA-50 sealant and DT-5400 4 inch tape
4. Spring Fasteners
 - a. Oval head stud and receptacle
 - b. Screwdriver slot
 - c. Self-ejecting
 - d. Dzus or equal
5. Angles, tie rod and shapes for reinforcing ducts: In accordance with SMACNA HVAC Duct Construction Standards, except as indicated on the Drawings
6. Duct connection system
 - a. Transverse bolted duct joints
 - b. Flanges with permanent, non-hardening sealant
 - c. Ductmate Industries Ductmate 25 and 35, Fabriduct TDC, or equal
7. Turning vanes
 - a. Galvanized steel ductwork: galvanized steel or painted black steel, except as indicated on the Drawings
 - b. Other ductwork: same material as ductwork
 - c. Construction per SMACNA HVAC Duct Construction Standards for
 - 1) Single wall vanes with 3/4 inch trailing edge
 - 2) Double wall vanes: Not acceptable
 - 3) Vane length: Provide separate equal size sections for vane length greater than those indicated in referenced Standards.
 - 4) Vane runners: Type 1 or 2 acceptable
 - d. Vane radius
 - 1) 2 inch radius: duct width up to 36 inches
 - 2) 4-1/2 inch radius: duct with 36 inches or larger
8. Low pressure round duct take-off fittings in rectangular duct
 - a. Factory-fabricated spin-in fitting
 - b. Die-formed galvanized steel
 - c. Balancing damper
 - 1) Spring loaded
 - 2) Locking regulator
 - 3) Sealed at both ends to prevent leakage
 - d. No scoop allowed for any application
 - e. Noll Manufacturing, Young Manufacturing or equal

2.3 ROUND AND OVAL DUCTWORK

A. General

1. Factory- or shop-fabricated spiral lock seam duct
 - a. No snap lock
 - b. Factory-fabricated longitudinal seam acceptable for ducts larger than standard factory sizes
2. Fittings
 - a. Same material and construction as duct in which installed
 - b. For ductwork exposed to occupant view, do not use fabricated fitting at taps to VAV boxes and outlets. Instead use saddle tap cut into continuous spiral duct. Intent is for spiral duct to be continuous for aesthetic reasons.
 - c. Tees
 - 1) 45 degree conical tap
 - 2) Center-line take-off, unless otherwise indicated on the Drawings
 - d. Elbows
 - 1) Seams
 - a) 4 inch and higher pressure class and all ducts exposed to occupant view: continuously welded seams
 - b) 1 inch to 3 inch pressure: spot welded with bonded seams
 - c) Adjustable elbows with sealed gores acceptable 1 inch pressure class and below and where concealed from occupant view
 - 2) Gores
 - a) 2 gores - less than 35 degrees
 - b) 3 gores - 36 degrees through 71 degrees
 - c) 5 gores - over 71 degrees

2.4 FLEXIBLE DUCTS

1. Flexible ducts
 - a. Use only where indicated on the Drawings
 - b. UL 181, Class I Air Duct
 - c. Labeled for compliance with CMC
 - d. Minimum working pressure
 - 1) 0 to 4 inch positive static pressure class: 4 inches
 - 2) 0 to 1 inch negative static pressure class: 1 inch
 - e. Insulated Flexible Duct
 - 1) Chlorinated polyethylene (CPE) inner liner duct permanently bonded to a vinyl or zinc coated spring steel wire helix. There shall be no insulation in contact with the air stream.
 - 2) Fiberglass insulating blanket; minimum R-value
 - a) Ducts outside the conditioned space and in conditioned envelope: 4.2
 - b) Ducts outside conditioned space and conditioned envelope: 8.0
 - 3) Low permeability outer vapor barrier of fiberglass bi-directional reinforced metallized film laminate
 - 4) Operating pressure rating shall be 2 inches w.g. Size equal to terminal inlet connection.
 - 5) Table below indicates rated sound attenuation for stated length.
 - 6) See Part 3 – Execution for installed length requirements.

Flow Band DIL-dB

Diameter	Length	1	2	3	4	5	6	7
6 inches	9 Ft.	10	29	30	32	33	38	37
8 inches	9 Ft.	10	29	28	30	32	36	36
12 inches	9 Ft.	10	28	23	25	28	35	35

- 7) Flexmaster 6, or equal
2. Flexible ductwork clamps
 - a. Straps listed for use with flexible ductwork
 - b. 2 inches and greater SP Class: Galvanized steel strap
 - 1) Adjustable toggle type
 - 2) Young Quick-Clamps or equal
 - c. Less than 2 inches SP class: Adjustable nylon strap
 - 1) With factory furnished installed tool
 - 2) Panduit PAN-TY Cable Ties, Heat Stabilized Nylon 6/6

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades
- B. See Section 23 09 00 – Energy Management & Control Systems

3.2 MOUNTING AND ALIGNMENT

3.3 DUCT CLASSIFICATION

- A. Minimum operating pressure for each duct system, general
 1. Scheduled static pressure for each fan or unit, positive or negative, unless otherwise indicated on the Drawings
 2. Adjust upward to nearest pressure class tabulated in SMACNA HVAC Duct Construction Standards
- B. Static pressure class, unless otherwise indicated on the Drawings
 1. As noted above.

3.4 DUCTWORK INSTALLATION

- A. General
 1. Install ducts in accordance with manufacturer's written installation instructions
 2. Coordinate fit and placement of ducts with work of other trades. Ducts must be placed so that piping, ceiling support grid, ceilings, light fixtures, etc. can be installed without warping, springing, or deforming ducts.
 3. Coordinate roof penetrations with architectural details.

4. Ductwork exposed to occupant view shall be run straight and true, in line with building elements. No sagging or out-of-true straight runs shall be acceptable. Sidewall taps and duct joints shall be clean and free of visual blemishes. Ducts shall have no external markings or tags.
5. Construct with gages, joints, bracing, reinforcing, and other details per latest CMC, ASHRAE, SMACNA and NFPA, unless specified otherwise
 - a. Comply with most stringent
 - b. Provide ducts with CMC gages or thicker when traversing rated corridors
6. Construct of galvanized sheet metal, except where stainless steel is indicated herein or on Drawings
7. Provide for duct rigidity by either of these methods
 - a. Beading at 12 inches on center, maximum
 - b. Crossbreak outward in ducts having positive internal pressure
 - c. Crossbreak inward in ducts having negative internal pressure
 - 1) Exception: All ducts exposed to rain shall outward crossbreak on top of the duct.
8. Duct dimensions indicated on the drawings are net inside clear dimensions.
9. Alter duct sizes on basis of equal friction where required to facilitate installation. Reflect changes in shop drawings for review by University's Representative.
10. At duct penetrations of walls, floors and ceilings where exposed to occupant view, provide sheet metal angle type escutcheons with no sharp corners or edges
 - a. Clearance from duct to opening shall not exceed 2 inches
 - b. Escutcheons shall overlap wall, floor, or ceiling surface by ½ inch minimum
11. Frame, trim, caulk and seal all duct penetrations through acoustical walls and partitions
12. Tapers
 - a. Pitch sides of duct in diverging or converging airflow maximum of 1 to 4 taper
 - b. Abrupt, bushing type fitting not allowed
13. Duct openings
 - a. Provide openings where required to accommodate thermometers, smoke detectors, controllers, and the like. Insert through airtight rubber grommets.
 - b. Where openings are provided in insulated ductwork for insertion of instruments, install insulation material inside metal ring for use as plug.
 - c. At fire dampers allow adequate length of duct to install access door.
14. Avoid penetration of ducts; provide airtight seal at unavoidable penetrations of hanger rods
15. No exposed sharp metal allowed
 - a. All exposed pins, screws and sharp objects shall be covered with hardening silicon
 - b. All exposed sheet metal edges shall be hemmed with exposed corners rounded smooth
 - c. Remove all sheet metal fish hooks
16. Install lining in ducts and plenums as specified in Section 230700 – Mechanical Insulation.
17. Flexible Connections
 - a. Coated glass fabric
 - b. For indoor or outdoor use
 - c. Use diaphragm type at plug fan inlets

- d. Install at connections to fans and air handling units and as indicated on Drawings
 - e. 2 inch slack in fabric; install to allow minimum movement of 1 inch in both tension and compression
 - f. Protect from direct solar and rain exposure with sheet metal shroud where outdoors
18. Volume dampers: Install dampers as specified in Section 23 30 00 – Duct Accessories
- B. Elbows and Splits
1. Use radius elbows in rectangular ducts unless otherwise indicated on the Drawings: Centerline radius dimension shall not be less than 1-1/2 duct width
 2. Where space does not permit duct radius specified above install short radius splitter vanes per SMACNA HVAC Duct Construction Standard
 - a. Number of vanes determined by ratio of inner radius (R) to duct width in plane of radius (W)
 - b. One vane: Radius to width ratio above 0.3
 - c. Two vanes: Radius to width ratio between 0.1 to 0.3
 - d. Three vanes: Radius to width ratio 0.1 and smaller
 3. Use square turns with turning vanes in rectangular ductwork, unless otherwise indicated on the Drawings, at following locations
 - a. Use only where full radius elbow cannot fit
 - b. Use only in ducts with 2000 fpm or less design velocity
 - c. In high and medium pressure ductwork spot weld turning vane to duct
- C. Rectangular Duct Joints
1. Transverse Joints
 - a. In medium pressure ductwork shall be Fabriduct TDC or Ductmate or equal
 - b. In low pressure ductwork shall be Fabriduct TDC or equal except that ducts under 19 inches longest side may be slip & drive (S&D)
 2. Longitudinal seams shall be Pittsburgh. Snap lock not allowed
- D. Round and oval ductwork
1. Joints between ducts
 - a. Made with beaded sleeve joints as scheduled
 - b. Duct sealer applied to male end
 - c. Mechanically fastened with sheet metal screws or pop rivets
 - d. Over joint and screw or rivet heads, apply coating of duct sealer.
 2. Joints, duct and fitting
 - a. Slip projecting collar of fittings into duct: Per SMACNA HVAC Duct Construction Standard
 - b. Apply duct sealer: Seal and tape as specified above
 - c. Mechanically fasten: Fastening schedule: Per SMACNA HVAC Duct Construction Standard
 3. Junctions between ducts
 - a. Branch take-off: 45 degrees or conical 90 degrees
 - b. Branch connections to low pressure rectangular ducts may be made with spin-in fittings
 4. Horizontal supports
 - a. One or two piece clamp band strap

- b. Minimum: one per section
 - c. Support fittings as required to prevent sagging
 - 5. Vertical Supports: one of the following
 - a. Clamp bands with extended ends supported by floor
 - b. Clamp bands with knee bracing
 - c. Pedestal at base of vertical
 - 6. Duct where exposed to occupant view:
 - a. Sealant shall be within joint only and not visible
 - b. No dings, dents, or blemishes.
- E. Flexible ductwork
- 1. Continuous, single pieces
 - 2. Length
 - a. Medium and high pressure: Not allowed
 - b. Low pressure
 - 1) Maximum 7 feet, except where longer lengths are indicated on drawings. Where longer lengths are shown, the last 3 feet to 7 feet shall be wire flex duct and remaining ductwork shall be aluminum flex duct.
 - a) Maximum two 90 degree bends (or equivalent). Radius to be no less than the diameter of the duct.
 - 2) Minimum length: 3 feet
 - 3. End Connections
 - a. Connect to duct collars, terminal unit connections and round air outlets per manufacturer's instructions
 - b. Secure with strap clamps specified above
 - 4. Installation
 - a. Support adequately to avoid excessive droop
 - b. Minimum inside bending radius not less than one duct diameter
 - c. Install as straight as possible except as shown on drawings for sound attenuation
 - d. Cut ducts to lengths required rather than create bends to take up excess lengths except as shown on drawings for sound attenuation
- F. Grille connections
- 1. Provide at entry to diffuser collar either
 - a. Straight duct for 1 duct diameters or greater
 - b. Full radius elbow
 - c. Side inlet plenum
 - 1) Height: 4 inches minimum taller than top of grille to provide room for uniform airflow to grille
 - 2) Width/length: 2 inches wider than duct or round diffuser collar, whichever is larger
 - 3) Internal surfaces lined with minimum 1/2 inch thick Type AL duct liner as specified under Section 230700 – Mechanical Insulation
 - 4) At contractor's option, where plenum is required at round neck diffuser, square neck diffuser with length and width equal to diffuser diameter may be substituted
 - d. Thermaflex FlexFlow Elbow or equal
 - 2. Connections at grilles shall be insulated to the extent the duct is insulated including the final register box.

3. Seal connections at grilles per seal class of upstream ductwork.
- G. Duct hangers and supports
1. General
 - a. Support horizontal ducts with hangers of size and spacing as indicated in pertinent SMACNA HVAC Duct Construction Standards
 - b. Attachment to structure: See Section 230529 – Hangers and Supports
 - c. Seismic restraints: See Section 230548 – Mechanical Sound, Vibration and Seismic Control
 2. Horizontal Duct Supports
 - a. Install hangers at each change in direction of duct
 - b. Strap hangers
 - 1) Extend strap down both sides of ducts
 - 2) Turn under bottom one inch minimum
 - 3) Metal screw hangers to
 - a) Bottom of duct
 - b) Upper and lower sides of ducts
 - c) Not more than 12 inches on center
 - c. Angle hangers
 - 1) Provide angle hangers formed by extended vertical bracing angles
 - 2) Or by rods connecting to bottom angles if size or bracing angles conform to hanger schedule
 - d. Vertical duct supports
 - 1) Support vertical ducts at every floor
 - 2) Use angles or channels mechanically fastened to ducts with screws or pop rivets.
 - 3) Set angles or channels on floor slab or structural steel members placed in opening, unless otherwise indicated on the Drawings
- H. Sound-rated duct packing
1. Provide packing for duct penetrations through full-height partitions per Section 230548 Mechanical Sound, Vibration, and Seismic Control.
- I. Joint Sealing
1. Seal ducts per the Seal Levels tables below
 - a. Provide more stringent sealing if required to meet requirements of Paragraph 5 These tables from Standard 90.1-2001 with modifications.

Seal Level Requirement				
Duct Location	Duct Type			
	Supply		Exhaust	Return
	Outdoors	A	A	A
Unconditioned Spaces	A	A	A	A
Return Air Plenums	A	A	A	A
Conditioned Spaces	A	A	A	A
Seal Level Definitions				
Seal Level	Sealing Requirements			
A	All transverse joints, longitudinal seams, and duct wall penetrations			
B	All transverse joints and longitudinal seams			
C	Transverse joints only			
Longitudinal seams are joints oriented in the direction of airflow. Transverse joints are connections of two duct sections oriented perpendicular to airflow. Duct wall penetrations are openings made by any screw fastener, pipe, rod or wire. Spiral lock seams in round and flat oval duct need not be sealed. All other connections are considered transverse joints, including but not limited to spin-ins, taps and other branch connections, access door frames and jambs, duct connections to equipment, etc.				

2. Ducts not exposed to weather: Seal using one of the following:
 - a. Duct sealer per Paragraph 2.02 D.2.a
 - b. Gasketed TDC or Duct-Mate
 - c. Flexible duct
 - 1) Secure with straps or clamps as specified herein.
 - 2) Supplement with duct tape, both inner and outer liner.
3. Duct exposed to weather
 - a. TDC or Duct-Mate joints: Utilize interior joint gasket material plus a bead of butyl rubber sealant at the joint and continuous metal clip or cleat over the top of all four joints (top bottom and sides).
 - b. Apply two part hard-setting joint tape to
 - 1) Horizontal joints
 - 2) Transverse joints
 - 3) TDC or Duct-Mate joints
 - 4) Duct penetrations
 - 5) Screws through duct
4. Indoor duct where exposed to occupant view: Sealant shall be within joint only and not visible
5. Fire and fire/smoke dampers: Sealant shall be listed as approved on manufacturer's UL installation sheet.
6. Seal punched holes and corner cracks

7. Seal all factory fabricated ducts, including transverse joints on gored elbows
8. Seal end caps
9. After installation and testing reseal joints found to be leaking at no additional cost to the University.

3.5 DUCT PRESSURE TESTING

A. Scope of Testing

1. HVAC Ductwork and Plenums
2. Duct Leak Test for Medium Pressure ductwork: The equipment required for this testing comprises a high pressure blower, orifice test pipe assembly and manometer with necessary valves and tubing. The ductwork section shall be placed under an air pressure of 6" of water with the blower, while any leakage flow through the orifice is measured on the manometer. The manometer readings shall be converted to CFM from a calibrated test curve. The leakage shall not exceed 19.2 CFM/100 s.f. for rectangular seal class "A" ductwork and 9.6 CFM/100 sf for round seal class "A" ductwork. (See calculations below). No less than 50 square feet of duct shall be tested at one time. All branches shall be tested at same time as the main. The Contractor shall provide test conditions, including the total square feet of ductwork under test. All fire dampers and access panels shall be installed. Testing of any complete section of the ductwork must be made before installation of the finished ceiling or before the ductwork is furred in inaccessible space, and must be witnessed by the University. Any leaks found must be properly repaired, or joints remade and the section retested until tight. Any leaks which cause objectionable noise must be repaired, regardless of the amount of the leakage. Perform tests in the presence of the University's representative. Maintain a set of Drawings for recording and sign off of each tested section. After completion of testing, turn drawings over to the University's Representative. All medium pressure ductwork is tested.
3. Duct Leak Test for Low Pressure Ductwork: Tests and leakage requirements are the same as for medium pressure ductwork except test at an air pressure of 2" of water. The leakage shall not exceed 7.8 CFM/100 s.f. for rectangular seal class "A" ductwork and 3.9 CFM/100 sf for round seal class "A" ductwork. (See calculations below). Test one representative low pressure supply air duct section on each floor consisting of ductwork between the terminal (terminal coil, or VAV or static pressure control terminal) and the outlets. Section tested shall not have less than two outlets. Test one representative low pressure exhaust duct branch at each floor from the inlets to the riser. The University shall select the representative low pressure ducts to be tested. If the representative section tests do not pass, test all low pressure ductwork.
4. Leak Test for plenums: Same as for medium pressure ductwork.

B. General

1. Tests conducted in presence of University's Representative
2. Use portable high pressure blower and necessary instruments to indicate amount of leakage
3. See Section 23 05 93 Testing, Adjusting and Balancing for testing procedures and accuracy of test instruments

4. Conduct orifice tests as prescribed in SMACNA HVAC Air Duct Leakage Test Manual, and make test before duct sections are concealed
 5. Procedure
 - a. Seal openings in ducts and plenums to be tested.
 - b. Connect test apparatus to test section using flexible duct connection or hose.
 - c. Close damper on blower suction side, to prevent excessive buildup of pressure.
 - d. Start blower and gradually open damper on suction side of blower.
 - e. Build up pressure in test section equal to static pressure class.
 - f. Noise generated from duct leakage not acceptable. Seal as required.
 - g. Determine amount of air leakage by makeup air flow measurements:
 - 1) Maximum permitted leakage for HVAC ductwork shall be:
$$CFM_{max} = (A/100) C_L P^{0.65}$$
where
 - CFM_{max} = the maximum permitted leakage, cubic feet per minute (cfm).
 - A = surface area of the tested duct sections, square feet.
 - CL = duct leakage class, cfm/100 square feet at 1 inch water column.
 - = 6 for rectangular sheet metal, rectangular fibrous ducts, and round flexible ducts
 - = 3 for round/flat oval sheet metal or fibrous glass ducts
 - P = test pressure which shall be equal to the design duct pressure class rating, inches water column.
 - 2) Maximum permitted leakage for life safety ductwork shall be per CMC 905.
 - 3) If leakage of duct exceeds permitted limit, repair leaks and retest duct sections at no additional cost to the University until permitted leakage limits are obtained.
 - a) If leakage of low pressure duct exceeds permitted limit, in addition to repair and re-testing, expand testing to include all low pressure ductwork.
 6. Visually mark tested sections with certification sticker and initials of field test inspector.
- C. Documentation
1. Submit certification of test results of compliance to Commissioning Authority.
 2. Include certified test results showing compliance per Section 230500 – Basic Mechanical Materials and Methods.

3.6 PROTECTION

- A. Follow control measures of SMACNA IAQ Guidelines for Occupied Buildings Under Construction, Chapter 3, latest edition as described in Section 01352 Construction IAQ Management plan.

- B. Protect stored on-site or installed absorptive materials from moisture damage.
- C. After fabrication in the shop, wipe down interior of each piece of supply air and return air ductwork with a lint-free rag, using a solution of 30% isopropyl alcohol and 70% water. Cap/seal supply, return, and exhaust air duct openings immediately after fabrication or cleaning. Schedule deliveries to the job site to match installation to avoid excessive storage at the job site. Store ductwork at the job site in closed trailers or in the immediate area in which it will be installed. Any ducts at the site that have any opening seals perforated are to be re-cleaned per shop cleaning requirements and re-sealed until needed for installation. Maintain caps/seals on all openings of installed ducts. If openings of installed ducts have their seals perforated, re-clean contaminated duct sections per shop cleaning requirements. Demonstrate the cleanliness quality control to the University.
- D. Prior to operating air handling systems, verify internal cleanliness of air handlers, plenums, and ducts, and that filters are in place. Any contamination requires re-cleaning per shop cleaning requirements. Demonstrate to the University the cleanliness of the systems before operation. Provide security protocol to limit access to systems to avoid contamination.
 - 1. No supply, return, or exhaust air systems are to be operated without the specific permission of the University.
 - 2. Provide filtration at return and exhaust air inlets of systems that are operated prior to completion of construction. Filtration shall have a Minimum Efficiency Reporting Value (MERV) of 8, as determined by ASHRAE 52.2-1999.
- E. Duct cleaning
 - 1. Using the connected fan(s) force air at high velocity through duct to remove accumulated dust
 - 2. Protect equipment and spaces, which may be harmed by excessive dirt with filters, or bypass during cleaning
 - 3. In areas, which must be kept dust free, seal all outlets duct tight. When closures are removed avoid spilling dust in room

3.7 GALVANIZING REPAIRS

- A. Repair galvanizing damaged by welding, scratches, etc., using Z.R.C., no known equal, cold galvanizing compound.

3.8 DUCT SMOKE DETECTORS

- A. Install duct smoke detectors provided under Division 26 - Electrical. Coordinate with electrical that the duct detectors have proper probe length and coverage and that the proper air velocity is provided.

3.9 WASTE MANAGEMENT

- A. Conform with Section 017419 - Site Waste Management Program.
- B. Collect off cuts and scrap and place in designated areas for recycling.

- C. Separate all other materials, including packaging and banding, in accordance with the Waste Management Plan and place in designated areas for recycling.

3.10 INSPECTION

- A. Verify that adequate clearance between ducts and adjacent walls or equipment is available to permit proper sealing, maintenance and repairs.

3.11 PRE-OPERATING CHECKS

- A. Before operating the duct systems: Set all manual dampers in full open position
- B. Complete the Pre-Functional Checklist, Section 239700 – Mechanical Commissioning, Part 4.

3.12 TESTING AND ADJUSTING

- A. Before starting the duct systems
 1. Clean the duct system.
 2. See Section 01 91 00 – Commissioning
- B. After starting the duct systems: Check for noise and leakage. Repair as required at no additional cost to the University.
- C. See Section 23 05 93 – Testing, Adjusting, and Balancing: Coordination with Balance Agency:
 1. Provide services of a sheet metal installer familiar with the system ductwork to provide assistance to the balancing agency during the initial phases of air balancing in locating all sheet metal dampers
 2. Install missing dampers
- D. See Section 23 97 00 – Mechanical Commissioning.

END OF SECTION

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SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following: All air terminal units including
 - 1. Dual Duct air terminal units
- B. Related Sections
 - 1. Section 23 05 00 – Basic Mechanical Materials and Methods

1.2 REFERENCE STANDARDS

- A. ARI Standard 885-98 – Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminal and Air Outlets
- B. ARI Standard 410 – Standard for Forced-Circulation Air-cooling and Air Heating Coils

1.3 QUALITY ASSURANCE

- A. Terminal units rated and certified in accordance with ARI Standard 880-98 Certification Program
 - 1. Heating and cooling coils rated in accordance with ARI Standard 410.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
- B. VAV Terminals
 - 1. Titus
 - 2. Price
 - 3. Krueger

2.2 VAV TERMINALS

- A. Variable Air Volume Terminal Units
 - 1. Single duct: Equal to Price RDV

B. General

1. Casings
 - a. Minimum 22-gage, galvanized steel
 - b. Leakage rating: 7 cubic feet per minute maximum leakage at 1 inch water column
 - c. Discharge duct connection
2. Flow sensor is furnished and mounted by manufacturer
 - a. Cross-flow airflow sensor. No exceptions
3. Controls (controller, air velocity transmitter, actuator, controller, control panel) is furnished by Section 23 09 00 – Energy Management and Control Systems.
 - a. Field or factory install controls – contractor option.
 - b. The average amplification factor for sizes 4 to 16 inch shall be greater than 2.0 and minimum amplification factor shall be 1.5. Provide documentation with submittal that substantiates this requirement.
 - c. The minimum amplification factors shall be as indicated in the table below. Provide documentation with submittal that substantiates this requirement.

Duct Diameter (in.)	Amplification Factor
4	1.64
6	3.08
8	2.39
10	2.31
12	2.77
14	2.02
16	2.12

- 1) Be rated for inlet or discharge duty, as indicated on the Drawings
- 2) Provide accurate flow sensing regardless of inlet duct configuration
- 3) Brass balancing taps and unit mounted airflow versus flow sensor pressure signal charts for field airflow measurements
- d. Control panel:
 - 1) Control panel to have cover to fully enclose VAV terminal controller
4. Radiated and discharge sound power
 - a. Equal or less in each octave band than terminal selections scheduled on the Drawings at noted capacities assuming 1.0 inch inlet static pressure, with a tolerance of + 2 dB in any band.
 - b. Due to added space and pressure drop, providing additional plenums or attenuators to meet sound power ratings is not acceptable.
5. Total pressure drop
 - a. Equal or less than terminal selections scheduled on the Drawings at noted capacities, with a tolerance of 0.02 inches of water
 - b. This limitation is in total, not static, pressure. Where total pressure is not listed on certified performance documents, provide a table of manual

adjustments of static pressure with velocity pressure calculated from inlet and outlet velocities.

6. Dampers
 - a. Heavy gage steel
 - b. Single blade damper; opposed blade dampers are not acceptable
 - c. Shaft rotating in self-lubricating Delrin or equal bearings; nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position.
 - d. Damper shall have durable synthetic seal. Foam seals are not acceptable.
 - e. Close-off leakage rating: 5 cubic feet per minute maximum leakage at 1.50 inches water column.

PART 3 - EXECUTION

3.1 INSTALLATION – VARIABLE VOLUME TERMINALS

- A. Coordinate with work of other trades.
- B. Install terminal units in accordance with manufacturer's written installation instructions.
- C. Support each unit at four corners with minimum, 1" x 18 gage sheet metal straps or 3/8 inch all-thread rod. Secure lower end of strap to the side of unit casing with minimum two #10 sheet metal screws, or bolt through casing with washers to prevent leakage. Bend end of strap and secure to bottom of casing with one #10 sheet metal screws.
- D. Supply duct connections: See Section 23 31 13 – Ducts
 1. Provide sheet metal duct connections at inlet; flexible not acceptable
- E. Sound attenuation discharge duct
 1. Variable Volume terminals
 - a. Downstream of units where indicated on the Drawings
 - b. Sound linings: Type AL. See Section 23 07 00 – Mechanical Insulation
 - c. Minimum lining 8 feet of duct downstream of terminal
- F. Coordinate access with respective trades
- G. See Section 23 09 00 – Energy Management & Control Systems

3.2 MOUNTING AND ALIGNMENT

- A. See Section 23 05 48 – Mechanical Sound, Vibration and Seismic Control

3.3 INSPECTION

- A. Verify that adequate clearance between air terminal units and adjacent walls or equipment is available to permit maintenance and repairs.

3.4 PRE-OPERATING CHECKS

- A. Before operating air terminal units
 - 1. See Section 01 91 00 – Commissioning
 - 2. Complete the attached Pre-Functional Test Data Sheet, Appendix 15840 A, for each air terminal unit

3.5 TESTING AND ADJUSTING

- A. Before starting air terminal units
 - 1. See Section 01 91 00 – Commissioning
 - 2. Complete the Pre-Functional Checklist, Section 23 97 00 – Mechanical Commissioning, Part 4.
- B. Start and test fans in accordance with manufacturers written installation instructions.
- C. Start up and adjust fans to insure proper operation.
- D. After starting air terminal units: Check for objectionable noise or vibration. Correct as needed at no additional cost to the University.
- E. See Section 23 05 93 – Testing, Adjusting, and Balancing
- F. See Section 23 97 00 – Mechanical Commissioning

3.6 TRAINING

- A. See Section 23 97 00 – Mechanical Commissioning.

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included in this section: materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following: All air outlets, inlets, grilles, registers and diffusers except where integral with manufactured piece of equipment
- B. Related Sections
 - 1. Section 01 91 00 – Commissioning
 - 2. Section 23 05 00 – Basic Mechanical Materials and Methods

1.2 QUALITY ASSURANCE

- A. Comply with ARI Standard 650 – Air Outlets and Inlets
- B. Comply with ASHRAE Standard 70 – Methods of Testing for Rating the Airflow Performance of Outlets and Inlets
- C. Comply with AMCA Standard 500 – Laboratory Methods of Testing dampers for Rating
- D. Comply with NFPA Standard 90A – Installation of Air Conditioning and Ventilating Systems
- E. Comply with BSR/NFPA 90B – Standard for the Installation of Warm Air Heating and Air Conditioning Systems
 - 1. Provide outlets and inlets that have, as minimum, throw and noise criteria ratings for each size device as listed in manufacturer's current data, rated as required by the above standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturer model numbers used as example of item and establish minimum level of quality and minimum standard options. Equivalent models of listed manufacturers are acceptable.
 - 1. Titus
 - 2. Price
 - 3. MetalAire
 - 4. Tuttle & Bailey

5. Or equal

2.2 GENERAL

- A. Manufacturer shall examine and approve of application of each outlet.
- B. Noise level at design capacities: no larger than diffuser selection indicated on the drawings.
- C. Volume dampers
 1. Do not provide dampers built into grille or directly attached to the grille unless specifically called out on drawings or in this Section.
 2. Where indicated - opposed blade volume damper key-operated adjustable from face of diffuser on register.
- D. Diffuser frame
 1. Frame type shall be coordinated with ceiling type. Refer to architectural reflected ceiling Drawings.
 - a. At lay-in ceilings provide tegular and/or narrow tee ceiling frames as required for the application.
 2. Plaster or drywall ceilings: lay-in diffuser with drywall frame (to allow for ceiling access through grille). Drywall frame to match diffuser color.
 3. No visible screw allowed on diffusers or frames, unless otherwise indicated on the Drawings.
- E. Outlets may be steel or aluminum unless otherwise indicated on the Drawings.
- F. Color
 1. Face and frame: As directed by the Architect.
 2. Internal parts of grille visible from occupied space, including all parts behind perforated face diffusers and visible parts of plenums: flat black

2.3 STYLES

- A. General
 1. See diffuser / grille schedule on the Drawings for outlet designation.
 2. Throw pattern per the Drawings
 3. Specific frame, border, and other product references refer to Titus Products, unless otherwise noted.

2.4 SCREENED OPENINGS

- A. Mesh
 1. 3/4 in. square pattern
 2. No. 16 galvanized wire
 3. Interwoven
 4. Welded or secured to frame

- B. Frames: Optional
 - 1. 1 inch by 1 inch by 1/8 inch galvanized steel angles
 - 2. Continuous around perimeter of screen

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate with work of other trades.
- B. Install air outlets and inlets in accordance with manufacturer's written installation instructions and Section 23 31 13 – Ducts.
- C. Return and exhaust registers: Install with blades oriented to prevent sight through outlets.
- D. Grille backs or plenums visible through grilles painted flat black
 - 1. Where ceiling space could be visible through inlets and outlets, provide sheet metal ducting to block line of sight, and paint flat black as described above.
- E. Transfer grilles
 - 1. See indications on the Drawings
 - 2. Wall installations, unless otherwise indicated, provide two grilles
 - a. One on each side of wall, except where open to return air plenum
 - b. Connecting sheet metal collar with 18 inch elevation offset for sound and light attenuation
- F. Provide duct screens at termination ducts as indicated on the Drawings

3.2 MOUNTING AND ALIGNMENT

- A. See Section 23 05 48 – Mechanical Sound, Vibration and Seismic Control
- B. All air outlets and inlets shall be secured to building
 - 1. Ceiling grilles shall be secured to prevent falling from ceiling during construction or service with minimum of two 16-gage ceiling wires, two 22-gage by 1 inch galvanized sheet metal strap or two #10 sheet metal screws.
 - 2. Comply with CBC Section 25.214
- C. Except where indicted, angular offsets, box connections, and other irregular connections at diffusers and registers are prohibited. Where location of diffusers and registers is governed by work in other Sections, such as integrated ceilings, set diffusers and registers to dimensions taken from Section performing the other work.
- D. Mount directional grilles as indicated on the Drawings.
- E. Adjust grille throw patterns
 - 1. As indicated on the Drawings

2. For double-deflection grilles, adjust rear blades horizontal and front blades in 45 degree pattern at each end gradually rotating to be almost straight at blades in center of grille.
3. Prior to test and balance

3.3 INSPECTION

- A. Verify mounting, direction and adjustments are installed as indicated on the Drawings.

3.4 TESTING AND ADJUSTING

- A. See Section 01 91 00 – Commissioning
- B. See Section 23 05 93 – Testing, Adjusting and Balancing
- C. See Section 23 97 00 – Mechanical Commissioning.

END OF SECTION

SECTION 26 00 00

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section includes general requirements specifically applicable to Divisions 26 including requirements from Division 1.

1.2 RELATED SECTIONS

- A. All included sections under Division 1
- B. All included sections under Division 26
- C. Plans
- D. Manufacturers' manuals, product bulletins, etc.

1.3 REFERENCE STANDARDS AND CODES

- A. Standards
 1. AEIC – Association of Edison Illuminating Companies
 2. ANSI – American National Standards Institute
 3. ASTM – American Society of Testing and Materials
 4. CBM – Certified Ballast Manufacturers Association
 5. EIA – Electronic Industry Association
 6. ICEA – Insulated Cable Engineers Association
 7. IEEE – Institute of Electrical and Electronics Engineers
 8. NEMA – The Association of Electrical and Medical Imaging Equipment Manufacturers
 9. FM - Factory Mutual
 10. UL – Underwriter's Laboratory's, Inc., Standards for Safety
- B. Local codes and authorities having jurisdiction
 1. City codes
 2. County codes
 3. Local fire department
- C. State codes and authorities having jurisdiction
 1. CBC – California Building Code
 2. CEC – California Electrical Code
 3. State of California Codes
- D. National codes and authorities having jurisdiction
 1. NESC – National Electrical Safety Code
 2. OSHA – Occupational Safety and Health Act

- E. Utilities
 - 1. Local cable company
 - 2. Local electrical company
 - 3. Local telephone company

- F. Code compliance.
 - 1. All work and materials shall comply with the latest rules, codes and regulations, including, but not limited to the following:
 - a. Occupational Safety and Health Act Standards (OSHA).
 - b. CCR, Title 24, Part 3: California Electrical Code (CEC)
 - c. All other applicable Federal, State and Local laws and regulations.
 - 2. Code compliance is mandatory. Nothing in these Drawings and Specifications permits work not conforming to National, State, and Local electrical and building codes. Where work is shown to exceed minimum code requirements, comply with Drawings and Specifications.
 - 3. No work shall be concealed until after inspection and approval by proper authorities. If work is concealed without inspection and approval, the Contractor shall be responsible for opening the concealed areas, making any required corrections and/or modifications to his work, and restoring the area to its previous condition

1.4 DEFINITIONS (APPLICABLE TO DRAWINGS AND SPECIFICATIONS)

- A. Provide: To supply, install and connect complete and ready for safe and regular operation of particular work referred to unless specifically otherwise noted.
- B. Install: To erect, mount and connect complete with related accessories.
- C. Supply: To purchase, procure, acquire and deliver complete with related accessories.
- D. Work: Labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation.
- E. Wiring: Raceway, fittings, wire, boxes, related items and connection.
- F. Concealed: Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces or in enclosures.
- G. Exposed: Either visible or subject to mechanical or weather damage, indoors or outdoors, including areas such as mechanical and storage rooms. In general, any item that is directly accessible without removing panels, walls, ceiling or other parts of structure.
- H. Indicated, Shown, or Noted: As indicated, shown or noted on Drawings or Specifications.
- I. Above Grade: Not buried in ground and not embedded in concrete slab on ground.
- J. Below Grade: Buried in ground or embedded in concrete slab on ground.
- K. Underground: Buried in ground, including under building slabs.

- L. Connect: Complete hookup of item with required services, including conduit, wire and other accessories.
- M. Furnish: Supply and deliver complete.
- N. Similar or Equal: Of base bid manufacturer, equal in materials, weight, size, design, and efficiency of specified product, equivalent to Base Bid Manufacturer's product.
- O. Reviewed, Satisfactory, Accepted, or Directed: As reviewed, satisfactory, accepted or directed by or to engineer.
- P. Motor Controllers: Manual or magnetic starters (with or without switches), individual pushbuttons, or hand-off-automatic (HOA) switches controlling the operation of motors.
- Q. Control Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.
- R. Contractor: Electrical Sub Contractor unless stated otherwise.
- S. Use (verb): Furnish and install as defined above.

1.5 LICENSES, FEES AND PERMITS

- A. Pay for all City, County or State electrical licenses, fees and permits. Arrange for all required in sections by agencies or authorities having local jurisdiction. The owner shall pay for all inspection fees and permits

1.6 CONDITIONS AT SITE

- A. A visit to the site is required of all bidders prior to submission of bid. All will be held to have familiarized themselves with all discernible conditions and no extra payment will be allowed for work required because of these conditions, whether specifically mentioned or not.
- B. Underground or overhead lines or other services that are damaged as a result of this work shall promptly be repaired at no expense to the Owner and to complete satisfaction of the Owner.

1.7 DRAWINGS AND SPECIFICATIONS

- A. All Drawings and all Divisions of these Specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.
- B. The Contract Drawings are diagrammatic and indicate the general arrangement of equipment and wiring. Most direct routing of conduit and wiring is not assured. Exact requirements shall be governed by architectural, structural and mechanical conditions of the job. Consult all other Drawings in preparation of the bid. Extra lengths of wiring or addition of pull or junction boxes, etc., necessitated by such conditions shall be included

in the bid. Check all information and report any apparent discrepancies before submitting bid.

- C. Right is reserved to make change up to ten (10) feet in location of any outlet, device, or equipment prior to roughing in without increasing contract cost.
- D. Equipment and fixtures shall be connected to provide circuit continuity in accordance with applicable codes, whether or not each piece of conductor, conduit or protective device is shown between items of equipment or fixtures and the point of circuit origin.

1.8 SAFETY AND INDEMNITY

- A. Safety: The Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours.
- B. No act, service, Drawing review or construction review by Owner, the Architect, the Engineers or their Consultants, is intended to include review of the adequacy of the Contractor's safety measures, in on or near the construction site.

1.9 RECORD DRAWINGS

- A. Submit record Drawings under provisions of Section 013000.
- B. Submit prior to final acceptance inspection, one complete marked-up set of reproducible engineering design Drawings.
 - 1. Fully illustrate revisions made by crafts in course of work.
 - 2. Include field changes, adjustments, variances, substitutions and deletions, including Change Orders.
 - 3. Indicate exact location of raceways, equipment, and devices.
 - 4. Indicate exact size and location of underground and under floor raceways, grounding conductors, and duct banks.
 - 5. The record Drawings shall show all the work actually constructed and originally shown on the Drawing based upon the field construction by the Contractor.
- C. These Drawings shall be for record purposes for Owner's use and are not considered Shop Drawings.

1.10 MANUFACTURER'S INSTRUCTIONS

- A. Where the Specifications call for an installation to be made in accordance with manufacturer's recommendations, a copy of such recommendations shall at all times be kept in the job superintendent's office and shall be available to the Owner's representative.
- B. Follow manufacturer's instructions where they cover points not specifically indicated on Drawings and Specifications. If they are in conflict with the Drawings and Specifications, obtain clarification from the Architect or Engineer before starting work.

- C. One (1) set of equipment manufacturer's Drawings shall be submitted to the Engineer for their record.

1.11 OPERATING AND MAINTENANCE MANUALS

- A. Operating and maintenance manuals and closeout documents are used interchangeably.
- B. Submit operating and maintenance manuals of equipment in the following format. Owner shall decide which format they prefer.
 - 1. Three (3) hardcopy sets
 - 2. PDF format
- C. For specific requirements, see the sections in which the equipment is specified.

1.12 QUALITY ASSURANCE

- A. Provide a meaningful quality assurance program. To assist the Contractor in this program, the Specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating facility within the scope of this project.
- B. The Contractor shall insure that workmanship, materials employed, required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.

1.13 GUARANTEE

- A. Guarantee the installation free from defects of workmanship and materials for a period of one (1) year after Date of Certificate of final payment and promptly remedy any defects developing during this period, without charge.

1.14 BIDDING

- A. The contractor shall bid on the plans, specifications, etc. that constitute the contract documents.
- B. The contractor shall not attempt to modify the contract documents without the approval of the electrical engineer.
- C. All "value engineering" proposals shall be submitted in to the electrical engineer writing.
- D. If the contractor makes changes to the contract documents not approved by the electrical engineer, the contractor will still be responsible for installing all devices, conductors, conduits, etc. the contract documents call for.

1.15 ABBREVIATIONS

AIC	Amps interrupting capability
ANSI	American National Standards Institute
ASTM	ASTM International, formerly American Society for Testing and Materials
ATC	Astronomical time clock
CAD	Computer aided design
CATV	Cable television
CBC	California Building Code
CCTV	Closed circuit television
CEC	California Electrical Code
CFC	California Fire Code
CFL	Compact fluorescent lamp
CFR	Code of Federal Regulations
CMC	California Mechanical Code
CPC	California Plumbing Code
CSFM	California State Fire Marshal
DPDT	Double pole, double throw
DPST	Double pole, single throw
DSA	Division of the State Architect
DVR	Digital video recorder
EIA	Electronic Industries Association
EMT	Electrometallic conduit
EOR	Engineer of record
EPA	Effective projected area
FACP	Fire alarm control panel
FMC	Flexible metallic conduit

GRS Galvanized, rigid steel conduit
HID High intensity discharge
HPS High pressure sodium
HVR Hybrid video recorder
ICC-ES International Code Council Evaluation Service
IDF Intermediate data frame
IEEE Institute of Electrical and Electronic Engineers
IES Illuminating Engineering Society of North America
IGBT Insulated Gate Bipolar Transistor
IMC Intermediate metallic conduit
IOR Inspector of record
LAN Local area network
LCD Liquid crystal display
LCP Lighting control panel/lighting relay panel
LED Light emitting diodes
LRP Lighting control panel/lighting relay panel
MDF Main data frame
MH Metal halide
NEC National Electrical Code
NEMA Association of Electrical Equipment and Medical Imaging Manufacturers
NETA National Electrical Testing Association
NFPA National Fire Protection Association
NIST National Institute of Standards and Technology
OCPD Overcurrent protection device
PDF Portable document format
PG&E Pacific Gas and Electric

PQM	Power quality monitor
PTZ	Pan, tilt, zoom
PVC	Polyvinyl chloride
SCCR	Short circuit current rating
SCE	Signal current expander
SPD	Surge protective device
SPDT	Single pole, double throw
SPST	Single pole, single throw
TFT	Thin film transistor
THD	Total harmonic distortion
TIA	Telecommunications Industries Association
TVSS	Transient voltage surge suppression/suppressor UL Underwriters' Laboratories
USB	Universal series bus
UPS	Uninterruptable power supply
VFD	Variable frequency drive
VFD	Vacuum fluorescent display
VOIP	Voice over Internet protocol
VPN	Virtual private network
WAN	Wide area network

PART 2 - PRODUCTS

2.1 MATERIAL APPROVAL

- A. All materials must be new and bear Underwriters' Laboratories label. Materials that are not covered by UL testing standards shall be tested and approved by an independent testing laboratory or a governmental agency.
- B. Material not in accordance with these Specifications may be rejected either before or after installation.

- C. Materials or equipment specified by:
 - 1. Name of manufacturer.
 - 2. Brand or trade name.
 - 3. Catalog reference.

2.2 SUBSTITUTIONS

- A. Base the bid on use of materials specified.
- B. BEquipment other than specified will be considered for approval provided it meets previous items A through C and the following is submitted in writing by the Contractor to the Engineer to allow approval at least 14 days before the bid date:
 - 1. The request for permission to substitute shall be accompanied with a statement of the amount of money to be returned to the contract if the substitution is permitted.
 - 2. Return a completed request for substitution form.
- C. The engineer is the sole judge of acceptability of preferred substitutions.
- D. If a substitute is permitted, and any re design effort is thereby necessitated, the required re design shall be at the Contractor's expense.

2.3 SUBMITTALS

- A. Submit to architect, or engineer if no architect is involved, seven (7) copies of complete Shop Drawings and materials lists, as noted below, for review within thirty (35) days after award of contract. All proposed deviations from Specifications must be clearly listed and submitted separately under a prominent heading entitled "Substitutions."
 - 1. Fire Alarm Systems
 - 2. Communication Systems
 - 3. Pull Boxes and Cabinets
 - 4. Conduit and Wire
 - 5. Service and distribution
 - 6. Transformers

2.4 OPERATING AND MAINTENANCE MANUALS

- A. Submit Operating and Maintenance Manuals of equipment as specified under Division 1. Verify exact quantity with architect, or engineer if no architect is involved.

2.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be shipped in its original packages, to prevent damaging or entrance of foreign matter. Handling and shipping shall be performed in accordance with manufacturer's recommendations. Provide protective covering during construction.
- B. Replace at no expense to Owner, equipment or material damaged during the storage or handling, as directed by the engineer.

- C. Equipment shall be tagged with a weatherproof tag identifying equipment by name and purchase order number. Packing and shipping lists shall be included

PART 3 - EXECUTION

3.1 CLEARANCE

- A. Minimum code required clearances for electrical equipment shall not be violated.

3.2 WORKMANSHIP AND CONTRACTOR'S QUALIFICATIONS

- A. Only quality workmanship will be accepted. Haphazard or poor installation practice will be cause for rejection of work.
- B. The Electrical Contractor shall provide a Superintendent in charge of this work at all times to direct the quality of the installation.

3.3 COORDINATION

- A. Coordinate work with other trades to avoid conflict and to provide correct rough in and connection for equipment furnished under other trades and requiring electrical connections. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.
- B. Verify equipment dimensions and requirements with provisions specified under this Section. Check actual job conditions before fabricating work. Report necessary changes in time to prevent needless work. Changes or additions subject to additional compensation and agreed price shall be at Contractor's risk and expense.
- C. Provide temporary feeds and connections to areas and equipment as required to allow phased construction and operation.

3.4 CUTTING AND PATCHING

- A. All cutting and patching required for work of this Division is included herein. Coordination with General Contractor and other trades is imperative. Contractor shall bear the responsibility for and bear the added expense of adjusting for improper holes, supports, etc.

END OF SECTION

SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Materials, equipment fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction, for the following:
 - 1. Conduit and raceways
 - 2. Wire and cables
 - 3. Outlet boxes
 - 4. Junction boxes
 - 5. Pull boxes
 - 6. Grounding

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1
 - 1. Section 013000: Administrative Requirements
 - 2. Section 013300: Submittal Procedures
 - 3. Section 014000: Quality Requirements
 - 4. Section 016000: Product Requirements
 - 5. Section 017000: Execution and Closeout Requirements
 - 6. All other included sections under Division 1
- B. All included sections under Division 26
- C. Plans
- D. Manufacturers' manuals, product bulletins, etc.

1.3 REFERENCE STANDARDS AND CODES

- A. Published specification standards, tests or recommended methods of trade, industry or government organizations apply to work in this section as cited in Section 260000.
 - 1. American Society for Testing and Materials
 - a. ASTM B3: Standard Specification for Soft or Annealed Copper Wire
 - b. ASTM B33: Standard Specification for Tin-Coated or Annealed Copper Wire for Electrical Purposes
 - c. ASTM B738: Standard Specification for Fine-Wire Bunch-Stranded and Rope-Lay Bunch-Stranded Copper Conductors for Use as Electrical Conductors
 - d. ASTM B355: Standard Specification for Nickel-Coated, Soft or Annealed Copper Wire

- e. ASTM D412: Standard Test Methods for Vulcanized Rubber and Thermo-
plastic Elastomers—Tension
- 2. California Electrical Code (CEC)
- 3. Institute of Electrical and Electronic Engineers (IEEE)
 - a. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and
Earth Surface Potentials of a Ground System Part 1: Normal Measure-
ments
 - b. IEEE 82: Standard Test Procedure for Impulse Voltage Tests on Insulated
Con- ductors
 - c. IEEE 95: Standard Test Procedure for Impulse Voltage Tests on Insulated
Con- ductors
 - d. IEEE 141: Recommended Practice for Electric Power Distribution for Indus-
trial Plants
 - e. IEEE 142: IEEE Recommended Practice for Grounding of Industrial and
Com- mercial Power Systems
 - f. IEEE 241: Recommended Practice for Electric Power Systems in Commer-
cial Buildings
 - g. IEEE 242: Recommended Practice for Protection and Coordination of In-
dustrial and Commercial Power Systems (IEEE Buff Book)
 - h. IEEE 399: Recommended Practice for Industrial and Commercial Power
Systems Analysis (Brown Book)
 - i. IEEE 442: Guide for Soil Thermal Resistivity Measurements
 - j. IEEE 576: Recommended Practice for Installation, Termination, and Testing
of Insulated Power Cable as Used in Industrial and Commercial Applica-
tions
 - k. IEEE 1185: Recommended Practice for Cable Installation in Generating
Stations and Industrial Facilities
 - l. IEEE 1584: Guide for Performing Arc Flash Hazard Calculations
 - m. IEEE 1584a: Guide for Performing Arc-Flash Hazard Calculations—Amend-
ment 1
 - n. IEEE 1584b: Guide for Performing Arc-Flash Hazard Calculations—Amend-
ment 2: Changes to Clause 4
- 4. Underwriters' Laboratories
 - a. UL 1: Flexible Metal Conduits
 - b. UL 4: Armored Cable
 - c. UL 5: Surface Metal Raceways and Fittings
 - d. UL 5A: Nonmetallic Surface Raceways and Fittings
 - e. UL 5B: Standard for Strut-Type Channel Raceways and Fittings
 - f. UL 5C: Standard for Surface Raceways and Fittings for Use with Data, Sig-
nal, and Control Circuits
 - g. UL 6: Electrical Rigid Metal Conduit – Steel
 - h. UL 13: Power Limited Circuit Cables
 - i. UL 83: Thermoplastic Insulated Wires and Cables
 - j. UL 310: Electrical Quick-connect Terminals
 - k. UL 360: Liquid Tight Flexible Steel Conduit
 - l. UL 444: Communications Cables
 - m. UL 467: Grounding and Bonding Equipment
 - n. UL 486A: Wire Connectors
 - o. UL 486B: Wire Connectors
 - p. UL 486C: Splicing Wire Connectors

- q. UL 486D: Sealed Wire Connector Systems
- r. UL 486E: Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
- s. UL 493: Thermoplastic Insulated Underground Feeder and Branch Circuit Cables
- t. UL 510: Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
- u. UL 514A: Metallic Outlet Boxes
- v. UL 514B: Conduit, Tubing, and Cable Fittings
- w. UL 514D: Cover Plates for Flush-mounted Wiring Devices
- x. UL 635: Insulating Bushings
- y. UL 651: Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
- z. UL 797: Electrical Metallic Tubing – Steel
- aa. UL 870: Wireways, Auxiliary Gutters, and Associated Fittings
- bb. UL 969: Marking and Labeling Systems
- cc. UL 1063: Machine Tool Wires and Cables
- dd. UL 1242: Standard for Electrical Intermediate Metal Conduit - Steel
- ee. UL 1332: Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment
- ff. UL 1446: Systems of Insulating Materials – General
- gg. UL 1479: Fire Tests of Through Penetration Firestops
- hh. UL 1565: Position Devices (includes cable ties and clamps)
- ii. UL 1581: Reference Standard for Electrical Wires, Cables, and Flexible Cords
- jj. UL 1652: Flexible Metallic Tubing
- kk. UL 1685: Vertical-tray Fire Propagation and Smoke Release Test for Electrical and Optical Fiber Cables
- ll. UL 1773: Standard for Termination Boxes
- mm. UL 1977: Component Connectors for Use in Data, Signal, Control, and Power Applications
- nn. UL 2024: Standard for Signaling, Optical Fiber and Communications Raceways and Cable Routing Assemblies
- oo. UL 2029: Gas/Vapor Blocked Cable Classified for Use in Class 1 Hazardous (Classified) Locations
- pp. UL 2062: Enclosures for Use in Hazardous (Classified) Locations
- qq. UL 2196: Test for Fire Resistive Cables
- rr. UL 2237: Multi-point Interconnection Power Cable Assemblies for Industrial Machinery
- ss. UL 2238: Standard for Cable Assemblies and Fittings for Industrial Control and Signal Distribution
- tt. UL 2239: Hardware for the Support of Conduit, Tubing, and Cable
- uu. UL 2250: Standard for Instrumentation Tray Cable
- vv. UL 2225: Cables and Cable Fittings for Use in Hazardous (Classified) Locations
- ww. UL 2239: Hardware for the Support of Conduit, Tubing, and Cable
- xx. UL 2256: Nonmetallic Sheathed Cable Interconnects
- yy. UL 2257: Identification Tests for Jacket and Insulation Materials Used in Plenum Cables
- zz. UL 2459: Insulated Multi-pole Splicing Wire Connectors
- aaa. UL 2556: Wire and Cable Test Methods

1.4 QUALITY ASSURANCE

- A. Equipment and accessories shall be the product of a manufacturer regularly engaged in its manufacture.
- B. Supply equipment and accessories new, free from defects.
- C. Equipment and accessories in compliance with the applicable standards listed in Article 1.3 of this section and with applicable national, state and local codes.
- D. Items of a given type shall be the products of the same manufacturer.
- E. Deliver, store and protect products under provisions of Section 016000.
- F. Ship equipment in its original packages, to prevent damaging or entrance of foreign matter. Perform handling and shipping in accordance with manufacturer's recommendations. Provide protective covering during construction.
- G. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by the engineer.
- H. Tag items with a weatherproof tag identifying equipment by name and purchase order number. Include packing and shipping lists.

1.5 SUBMITTALS

- A. Submit under provisions of Section 013000 or 013300.
- B. Submittals shall include the following:
 - 1. Table of contents
 - 2. A complete set of detailed manufacturer's specifications describing and illustrating all standard and special components and materials
 - 3. Part numbers
 - 4. Evidence of compliance with the applicable standards listed under Article 1.3 of this section
 - 5. Maintenance instructions and intervals
 - 6. Calibration procedures and intervals
 - 7. A complete set of drawings for any special items
 - 8. Wiring diagrams
- C. Electronic submittals shall be searchable
- D. Seismic Restraint and Anchorage: Provide complete seismic anchorage and bracing for the lateral and vertical support of conduit and electrical equipment in accordance with CBC, Title 24, Part 2, Section 1615A.1 and ASCE 7-05 Section 13.6, and all provisions of this Section.
 - 1. Submit calculations prepared and signed by a Structural Engineer licensed in the State of California, showing compliance with the above for all electrical equipment weighing more than 50 pounds, excepting items corresponding exactly in configuration and weight to those specified and detailed. Where anchorage details are

not shown on drawings, the field installation shall be subject to the approval of the Electrical Engineer.

2. All equipment mounted on concrete shall be secured with steel stud expansion anchors requiring a drilled hole. Power driven anchors are not acceptable. Minimum spacing shall be 10 diameter center to center and 5 diameters center to edge of concrete. Maximum allowable stresses for tension and shear shall be 80% of the ICC Evaluation Services research or evaluation report values. Acceptable manufacturers are Hilti, Red Head, and Simpson Strong Tie.
3. Conduit and suspended equipment shall be provided with supports and seismic restraints in accordance with Unistrut, Inc. Seismic Bracing Guide, or Super Strut Inc., Seismic Restraint System guide. Support requirements shall be based upon similar equipment; i.e., water piping as equivalent to conduit with wire fill. A copy of the guide shall be on the job site during construction.

- E. The submittal shall be substantially complete for all items and equipment furnished under this section.
- F. Individual drawings and data sheets submitted at random intervals will not be accepted for review.
- G. Substitutions: Items of same function and performance shall be submitted in conformance with Division 1.

1.6 OPERATONAL AND MAINTENANCE MANUALS

- A. Submit operation and maintenance manuals in accordance with Section 260000.
- B. The manuals shall, at minimum, include the following:
 1. Table of contents
 2. Manufacturer (including contact information)
 3. Model number
 4. Voltage ratings
 5. Current ratings
 6. List of capabilities
 7. Environmental ratings
 8. NEMA enclosure type
 9. Maintenance instructions and intervals
 10. Calibration procedures and intervals
 11. Installation instructions
 12. Repair instructions (where applicable)
 13. As-built drawings.
- C. Provide manuals in one of the following formats:
 1. Three hardcopies
 2. PDF

PART 2 - PRODUCTS

2.1 CONDUIT AND OTHER RACEWAYS

- A. Rigid Conduit, also referred to as Galvanized Rigid Steel Conduit (GRS)
 - 1. Material: High strength steel
 - 2. Coating
 - a. All uses: hot-dipped galvanized
 - b. Underground or corrosive areas
 - 1) 40-mil, UV stabilized PVC coated
 - 2) Coating shall conform to NEMA RN-1
 - c. Fittings shall be threaded.
 - d. Conduit shall be UL-6 listed.
- B. Intermediate Metal Conduit (IMC)
 - 1. Material: Steel
 - 2. Coating
 - a. All uses: Hot-dipped galvanized
 - b. Underground or corrosive areas.
 - 1) 40-mil, UV stabilized PVC coated.
 - 2) Coating shall conform to NEMA RN-1
 - 3. Conduit shall be UL-1242 listed.
- C. Electrical Metallic Tubing (EMT)
 - 1. Material: Steel
 - 2. Coating
 - a. All uses: hot-dipped galvanized
 - b. Underground or corrosive areas
 - 1) 40-mil, UV stabilized PVC coated
 - 2) Coating shall conform to NEMA RN-1
 - 3. Fittings shall be threaded.
 - 4. Connectors and couplings
 - a. Water tight, steel compression type exterior and in wet locations. Use ETP Fittings InspectoRidge or approved equal when possible.
 - b. Steel set screw type in interior, dry locations.
- D. Non-metallic conduit
 - 1. Conduit shall be schedule 40 PVC (minimum)
 - 2. Approved for use as non-metallic raceway with 90°C conductors
 - 3. Comply with NEMA TC-2 and NEMA TC-3
- E. Flexible Metallic Conduit
 - 1. Material: High strength, hot-dipped galvanized steel
 - 2. Construction: Interlocked
 - 3. Conduits in damp, wet, or corrosive areas shall be liquid tight type with PVC jacket extruded over the steel conduit.
- F. Fittings and accessories
 - 1. Fittings and accessories for all conduit types shall be approved for the purpose and equal in all respects to the conduit or raceway.

2. Fittings and accessories for metallic conduits shall be made of ferrous metal and galvanized after fabrication.
- G. Pull lines
1. All conduits shall have a minimum of one pull line.
 2. Pull line shall be 1/8 inch diameter, yellow color.
 3. All pull lines shall be tagged at both ends so as to indicate the length of the conduit run, source, and the destination. (See section 3.3, A, 6).
 4. Pull lines shall be Tubbs Cordage "Polyline" or approved equal.
- H. HWireways
1. NEMA type
 - a. NEMA-1 for dry locations
 - b. NEMA-3R or NEMA-4 for damp and wet locations
 - c. EMA-4X for corrosive locations
 2. Metal type
 - a. Non-corrosive locations: mild steel
 - b. Corrosive locations: stainless steel
 3. Thicknesses
 - a. 6"x6" cross-section and smaller: 16 gauge
 - b. 8"x8" cross-section and larger: 14 gauge
 4. Finish: The entire enclosure shall be finished as follows:
 - a. Degreasing
 - b. Cleaning
 - c. Phosphatizing
 - d. Electrostatic deposition of polymer polyester powder coating followed by baking to produce a hard durable finish.
 - 1) The average thickness of the paint film shall be 2.0 mils.
 - 2) Paint film shall be uniform in color and free from blisters, sags, flaking and peeling
 - e. Finish shall conform to UL 50 and UL 50E.
 - f. Color shall match surrounding area.
 5. Covers
 - a. Wireways shall have hinged covers.
 - b. NEMA 3R, 4 and 4X wireways shall be a gasket on the inside of the cover to seal the wireway when cover is closed.
 - c. Covers shall have latches to secure the cover in the closed position.
 6. Wireways shall be UL listed.
- I. Cable Trays
1. Material: High strength steel
 2. Coating
 - a. All uses: hot-dipped galvanized
 - b. Underground or corrosive areas: 40-mil, UV stabilized PVC coated, coating shall conform to NEMA RN-1
 3. Construction
 - a. Trays shall be ladder type unless otherwise noted.
 - b. Maximum distance between cross-members shall be 12 inches.
 4. Trays shall meet NEMA VE-1 standards.

- J. Raceways shall be UL listed.

2.2 WIRE AND CABLE

- A. Conductors for power and lighting systems 600V or less:
1. Conductors shall be 90°C rated.
 2. Conductors size #12 AWG and larger shall be stranded copper.
 3. Type:
 - a. THWN for wet or underground locations
 - b. THHN for dry locations.
 - c. 90°C rated
 4. Minimum conductor size for voltage drop:
 - a. Minimum size #12 AWG for runs 50 feet or less for 208/120V systems or 100 feet or less for 480/277V systems
 - b. Increase conductor by one size by one method below:
 - 1) For each additional 50 feet for 208/120V systems or 100 feet for 480/277V systems.
 - 2) Calculate voltage drop and size as directed by CEC Voltage Drop Restrictions
 - c. Underground circuits shall be #8 AWG minimum wire, unless otherwise noted.
 - d. Once the contractor has determined conductors' route, calculate the minimum size to meet maximum voltage drop allowed per CEC using $D_{min} = C * L * I / (V_D * N)$.
 - 1) D_{min} is the minimum diameter (circular mills)
 - 2) $C=24$ for copper, $C=39$ for aluminum
 - 3) L is conductor length (feet)
 - 4) I is the current (amps)
 - 5) V_D is the maximum allowable voltage drop (volts)
 - 6) N is the quantity of parallel conductors per phase
 5. Minimum size conductors for OCPD shall be determined from CEC Table 310.16 with ampacity corrected for 115°F.
 6. Conductor size shall be the largest size to meet maximum voltage drop (2.2 A 4) and to meet CEC ampacity requirements (2.2 A 5).
- B. For Signal and Communication Circuits:
1. Special Cables: As specified on Drawings.
 2. Conductors for general communications use: Stranded copper conductor, #16 AWG minimum, with THWN insulation for underground or wet locations and THHN insulation for dry locations.
 3. Ends of stranded conductors shall be tinned.

2.3 OUTLET BOXES, JUNCTION BOXES AND PULL BOXES

- A. Above ground locations
1. Outlet Boxes
 - a. Hot-dipped galvanized after fabrication
 - b. Of required size, minimum 4 inches square, for flush mounted devices and lighting fixtures

- c. Cast type with gasketed covers for outdoor or wet locations.
 - d. Device and fixture back boxes shall be 2-1/4" deep, minimum.
 2. Junction and Pull Boxes
 - a. Use outlet boxes with appropriate covers as junction boxes wherever possible.
 - b. Larger junction and pull boxes
 - 1) Sheet steel, hot dipped galvanized after fabrication, finished gray baked enamel
 - 2) Sized according to code
 - 3) Screw-on covers
- B. In-ground pull boxes, handholes, and manholes
 1. Precast concrete type with required extension collars.
 2. Covers:
 - a. Lids shall be steel or reinforced concrete, as shown on plans. Pull box lids in traffic areas or large grassy areas subject to mowing by riding mowers shall traffic rated.
 - b. Covers shall include hold down bolts.
 - c. Top of cover shall be flush with top of box.
 - d. Covers shall be identified as ELECTRICAL, SIGNAL, or COMMUNICATIONS unless otherwise specified.
 3. Size boxes as indicated on Drawings. If size is not indicated on Drawings, use CEC as a minimum requirement.
 4. Boxes shall have 2" thick (minimum), reinforced concrete bottoms with 1" diameter drain hole over 12" of crushed rock.
 5. Boxes shall have approved cable supports.
 6. Concrete encased stubs for handholes extending five (5) feet beyond handhole.
 7. All pull boxes shall be no smaller than a Christy Concrete Products N09.
 8. All pull boxes shall be set flush to finished grade and shall have an 8-inch wide by 3-inch thick concrete mow strip poured around it.
 9. Manufacturer shall be Brooks Products, Oldcastle Enclosure Solutions (Christy), Jensen Precast, or approved equal.
 10. All sections between box, extension rings, etc. and penetrations shall be sealed with mortar.
- C. Floor Boxes
 1. Provide Walker or equal Modulink non-metallic floor box for concrete areas.
 2. Provide quantity of boxes required to accommodate each device.
 3. Provide Walker Wood Floor Boxes at wood floors provide quantity required to accommodate each device.
 4. Provide brass flip cover lids.
- D. Outlet boxes, junction boxes, pull boxes, etc. recessed in a concrete wall shall be deep masonry boxes.

2.4 CONDUIT AND EQUIPMENT SUPPORTS

- A. Conduit Supports:
 1. For individual conduit runs not directly fastened to the structure: Rod hangers.

2. For multiple conduit runs: Trapeze type conduit support designed for maximum loading deflection not exceeding manufacturer's recommendations.

B. Materials

1. All materials not otherwise noted:
 - a. Steel with the finished part hot dipped galvanized
 - b. Stainless steel for corrosive or damp environments
2. All bolts and nuts shall be stainless steel.

C. Supports anchored to earth shall be anchored in a concrete base per details.

D. Manufacturers shall be Caddy, Unistrut, Powerstrut, or approved equal.

E. All exposed channels shall have end caps made by the channel manufacturer and designed for use with the channel.

2.5 WIRE CONNECTORS

A. For wire size #8 AWG and smaller: Insulated, screw type, rated 105°C, 600V for building wiring and 1000V for fixtures; Scotchlok, Ideal, or approved equal.

B. For wire size #6 AWG and larger: T&B or approved equal screw type with 3M "#33+" or Plymouth "Slipknot Gray" tape insulation.

C. Underground wire splices.

1. Connect ends of conductors with copper compression connectors, 3M Scotchlok or approved equal.
2. Seal splice with inline resin splice kit approved for weather exposure, direct burial, and wet location; 3M Scotchcast or approved equal.

D. Only set screw, compression type connectors may be used for MC cables. Fish hook/open tag connectors are prohibited.

2.6 GROUNDING

A. Ground Rods

1. 3/4 inch diameter
2. Copper weld type
3. 10 feet in length.

B. Ground Wire: Conductors shall be medium-hard drawn, copper, and stranded, with sizes as shown on drawings.

C. Utilize CADWELD Multi-System Exothermic Welding for below grade ground connections.

D. Bolts, nuts, and washers shall be bronze, cadmium plated steel, or other corrosion resistant material approved for the purpose.

2.7 MISCELLANEOUS MATERIALS

- A. All screws, bolts, nuts, and washers on equipment outdoors or in wet or corrosive environments shall be stainless steel.

2.8 SEALANTS

- A. General purpose sealant: One part polysulfide or polyurethane, Federal Standard TT-S-00230c or two-part polyurethane, Federal Standard TT-SS-227E of Mameco Vulkem 116 or 227 or approved equal product manufactured by Products Research and Chemical Corporation. Pecora, Sika, Sonneborn, or Tremco may be substituted under provisions of Section 016000.
- B. Conduit sealant
 1. Two part, self curing urethane
 2. Non-sagging
 3. Liquid and gas tight
 4. Chemically stable once cured
 5. Compatible with conduit and conductor materials
 6. Designed for use as conduit seal
- C. Fire retardant sealant: Dow Corning Company, Type 3-6548 silicone RTV foam sealant, closed cell, 18 lb. density, 2-part system with UL certification. Type 96-081 one-part sealant shall be used for small spaces and cracks. 3M Fire Barrier Caulk CP25 is also acceptable.

2.9 IDENTIFICATION

- A. Nameplates:
 1. White, acrylic plastic suitable for indoor or outdoor use
 2. Face colored as below with engraved, white, 3/16" minimum, Arial or similar font characters
 - a. Equipment on normal systems: Black face
 - b. Equipment on emergency systems: Red face
 3. Clear plastic overlay suitable for indoor or outdoor use that can be replaced if vandalized.
 4. Sign shall include device name, voltage, and size.
 5. Outdoor nameplates shall be UV stable and fade resistant. B Pull line identification tags:
 - a. Aluminum plate
 - b. 1/8" tall (minimum), Arial (or similar) font, identifying text stamped on plate
 - c. Tags shall describing conduit's length, source, and destination.

PART 3 - EXECUTION

3.1 GENERAL

- A. Electric system layouts indicated on the Drawings are generally diagrammatic, but shall be followed as closely as actual construction and work of other trades will permit. Govern exact routing of cable and wiring and the locations of outlets by the structure and equipment served. Dimensions shall be taken from Architectural Drawings.
- B. Consult all other Drawings. Verify scales and report any dimensional discrepancies or other conflicts to architect, or engineer if no architect is involved, before submitting bid.
- C. Home runs to panelboards are indicated as starting from the outlet nearest the panel and continuing in the general direction of that panel. Continue such circuits to the panel as though the routes were completely indicated. Terminate homeruns of signal, alarm, and communications system in a similar manner.
- D. Avoid cutting and boring holes through structure or structural members wherever possible. Obtain prior approval of Architect and conform to structural requirements when cutting or boring the structure is necessary or permitted.
- E. Furnish and install necessary hardware, hangers, blocking, brackets, bracing, runners, required for equipment specified under this section.
- F. Provide necessary backing required to insure rigid mounting of outlet boxes.
- G. Install pull line in all conduits to remain that will have their conductors removed.

3.2 INSTALLATION OF CONDUIT

- A. Run conduit concealed unless otherwise noted or shown on Drawings.
- B. Run exposed conduit parallel to or at right angles to center lines of columns and beams.
- C. Run no conduit in concrete slabs or floors except at point of penetration. Penetrations shall be at right angles to slab surfaces.
- D. Install conduit above ceilings to avoid obstructing removal of ceiling tiles, lighting fixtures, air diffusers, etc.
- E. Conduit shall not cross any duct shaft or area designated as future duct shaft. Coordinated with mechanical work to avoid any conflict.
- F. Install pull line in empty conduit installed under this contract. Provide and install labels as describe in "Identification" sub-section.
- G. Spare conduits shall be capped to prevent intrusion of moisture and foreign objects.
- H. Minimum conduit size shall be 1/2 inches when installed above ground and 3/4 inches when installed underground or under building slabs. Increase conduit size as required

for wiring. Size for conduit, unless specifically shown otherwise, shall be determined from Table 3 for all conductors, Chapter 9 of latest National Electric Code.

- I. Conduit shall be rigid conduit, IMC, EMT, or plastic as follows:
 - 1. Above ground and dry locations: Use rigid conduit, IMC or EMT.
 - a. Wet locations: Rigid conduit, IMC.
 - b. Locations subject to mechanical injury: Rigid conduit or IMC only.
 - c. In concrete walls or block walls: Rigid steel conduit or IMC only.
 - d. Dry locations and not subject to mechanical injury: EMT (interior locations only), IMC, or rigid conduit.
 - 2. Underground: Use wrapped rigid steel or plastic.
 - a. NOT USED
 - 3. Bends
 - a. Make risers to grade with rigid steel long radius sweep conduit and rigid steel elbow fittings only.
 - b. Minimum radius of sweeps shall be 24 inches.

- J. Burial depth of conduit shall be as follows:
 - 1. Not used.

- K. Use flexible steel conduit in the following applications:
 - 1. Recessed lighting fixtures.
 - 2. Motor connections.
 - 3. Connection between fan plenum and structure.
 - 4. At expansion joints.
 - 5. At transformers and other equipment which produce vibration.

- L. Provide junction boxes/pull boxes as required to limit any power system conduit run to a maximum of four (4) 90 degree bends (two (2) 90 degree bends for signal communication system conduit runs) or to avoid "U" bends.

- M. Conduit Supports:
 - 1. Support conduit with Underwriters' Laboratories listed conduit support intervals required by the California Electric Code.
 - 2. Wire or sheet metal strips are not acceptable for conduit not directly fastened to structure or for multiple conduit runs.
 - 3. Individual conduit 1/2 inch and 3/4 inch size may be supported from ceiling support wire with Caddy clips only if acceptable to local code. Only one conduit is permitted to be attached to any ceiling support wire. Hang such conduit so as not to affect level of ceiling.
 - 4. Avoid attaching conduit to fan plenums. When it is necessary to support conduit from fan plenum, provide a length of flexible conduit between the section attached to the fan plenum and other sections. Provide a length of flexible conduit between the portion attached to the building to minimize transmission of vibration to the building structure.

- N. Conduit penetration of roof, walls, floors and ceilings shall be sealed to preserve the integrity of waterproofing, fire rating and soundproofing for which the roof, wall, floor or ceiling is designed. Materials and methods used shall conform to that specified under Architectural sections.

- O. Underground conduit and ducts 2 inches and larger shall be proven clear by pulling through a mandrel 1/4 inch smaller than the inside diameter.
- P. Where flush branch circuit panelboards or terminal cabinets are shown on walls, stub a minimum of four (4) 1 inch empty conduit into overhead ceiling spaces and four (4) 1 inch empty conduit into space below floor (if any) in addition to conduit required for circuit wiring.
- Q. Paint all exposed conduit to match its surroundings.
- R. Plastic conduits exposed to sun light shall be UV stabilized.
- S. Where rigid steel conduit runs in direct contact with the earth, conduit shall be wrapped with 10-mil PVC tape to form 40 mil of protection, or shall have factory applied PVC coating.
- T. Label all conduits at each terminus, pull box, and junction box.

3.3 INSTALLATION OF WIRE

- A. Install all wiring in raceway unless specifically shown or noted otherwise.
- B. Pull no wire into any portion of the conduit system until construction work which may damage the wire has been completed.
- C. Install wire continuous from outlet to outlet or terminal to terminal. Splices in cables when required shall be made in handholes, pull boxes or junction boxes. Make branch circuit splices in outlet boxes with 8 inches of correctly color-coded tails left in the box.
- D. Make splices in wires and cables utilizing specified materials and methods.
- E. Cables and wires passing through handholes shall be full looped inside the handhole (360 degree) and supported on galvanized steel racks, beginning 10" above the bottom of the handhole. Leave handhole in clean condition with debris removed.
- F. Make ground, neutral, and line connections to receptacle and wiring device terminals as recommended by manufacturer. Provide ground jumper from outlet box to ground terminal of devices when the device is not approved for grounding through the mounting screws.
- G. Provide Brady wire markers where number of conductors in a box exceed four (4).
- H. Wiring shall be tested for continuity (600V and below). All systems shall be entirely free from grounds, short circuits, and any or all defects.
- I. Measure and record the insulation resistance of 600 volt insulated conductors size #4/0 AWG and larger using a 500 volt megger for one minute. Make tests with circuits isolated from source and load.

- J. All conductor bends must have a radius greater than or equal to the manufacturer's listed bending radius.
- K. Label all conductors at each terminus, pull box, and junction box.

3.4 WIRE COLOR CODE

- A. Color code conductors. Wire sized #8 AWG and smaller shall have integral color coded insulation. Wire sizes #6 AWG and larger may have black insulation but shall be identified by color coded electrical tape at junction, splice, pull and termination points. Apply color tape with 1/2 lap to at least 6 inches of the conductor.
- B. Color code wire as follows:
 - 1. Conductors 208/120V 480/277V
 - 2. Phase A Black Brown
 - 3. Phase B red Orange
 - 4. Phase C Blue Yellow
 - 5. Neutral White White or Gray (consistent throughout facility)
 - 6. Ground Green Green

3.5 CONNECTIONS TO EQUIPMENT

- A. General:
 - 1. Furnish and install required power supply conduit and wiring to equipment. See below for other wiring required.
 - 2. Furnish and install a disconnect switch immediately ahead of and adjacent to each magnetic motor starter or appliance unless the motor or appliance is located adjacent to and within sight of the serving panelboard, circuit breaker or switch. Verify equipment nameplate current ratings prior to installation.
 - 3. Mount motor starters including those furnished under other sections or specifications, and provide power wiring to them.
 - 4. Install rough-in work for equipment from approved shop drawings to suit the specific requirements of the equipment.
 - 5. Furnish and install magnetic motor starters that are shown on the Drawings or specified under other divisions to be furnished under this division of work. Verify equipment nameplate ratings prior to installation and furnish adequately rated starters for the loads.
 - 6. Furnish and install manual thermal protection for motors not integrally equipped with thermal protection.
 - 7. Furnish and install 120V power to each control panel and time switch requiring a source of power to operate.
- B. Heating, ventilating, and air conditioning equipment:
 - 1. Coordinate with mechanical contractor for sizes, locations and details of motors, heating units, and control requirements.
 - 2. Provide required power supply conduit and wiring to equipment.
 - 3. Provide a suitable means of disconnect switch immediately ahead of and adjacent to each motor and appliance unless the motor or appliance is located adjacent and within sight of the service panelboard, circuit breaker or switch at a distance

allowed by codes. Verify equipment nameplate current ratings prior to installation. Provide a disconnect means at each magnetic motor starter.

4. Provide magnetic motor starters required under this division of work.
5. Provide manual thermal protection for motors not integrally equipped with thermal protection.
6. Line and low voltage temperature control and interlock wiring, conduit, and required connections are a part of other divisions unless specifically shown or noted on the Drawings as to be furnished under this section.
7. Provide 120V power supply to control panels, time switch furnished and installed under other divisions of work.
8. Furnish and install 120V power to each duct detector scheduled for operation of fire dampers or shut down of mechanical equipment. Coordinate the exact quantity and locations with the mechanical drawings.

C. Plumbing and other contractor-furnished and Owner-furnished equipment:

1. Required power and control conduit, wiring and connections are included under this section of the work. Control sensing and alarm devices will be furnished under the respective section of the contract supplying the equipment unless noted otherwise. These devices will be located in pipes, ducts, vessels, tanks, etc., and will be mounted in a place by the Contractor furnishing the devices. Other devices shall be mounted under this section of the work.
2. Control panels for packaged equipment will be furnished under the respective section of the contract supplying the equipment unless otherwise noted. Installation and connection of the control panels are under this section of the work.

3.6 SYSTEM NEUTRAL GROUND

- A. Not used.

3.7 EQUIPMENT GROUND

- A. Ground non-current carrying metal parts of electrical equipment enclosures, frames, or conductor raceways to provide a low impedance path for line to ground fault current and to bond all non current carrying metal parts together. Install a ground conductor in each raceway system. Equipment ground conductor shall be electrically and mechanically continuous from the electrical circuit source to the equipment to be grounded. Size ground conductors per CEC 250.95 unless otherwise shown on drawings.
- B. Grounding conductors shall be identified with green insulation. Where green insulation is not available, on larger sizes, black insulation shall be used and suitably identified with green tape at each junction box or enclosure device.
- C. Install metal raceway couplings, fittings and terminations secure and tight to insure good ground continuity. Provide grounding bushing and bonding jumper where metal raceway is not directly attached to equipment metal enclosure and at concentric knockouts.
- D. Lighting fixtures shall be securely connected to equipment ground conductors. Outdoor lighting standards shall have a factory installed ground for terminating the ground wire.

- E. Motors shall be connected to equipment ground conductors with a conduit grounding bushing and with a bolted solderless lug connection on the metal frame.

3.8 STRUCTURAL GROUND

- A. Not used.

3.9 IDENTIFICATION

- A. Provide and install nameplates on all switchboards, distribution boards, panels, motor starters, VFDs, transformers, safety switches/disconnects, push buttons, selector switches, pilot lights, and other similar devices. Fasten nameplates to equipment with one sheet metal screw at each corner.
- B. Provide and install labels on lighting switches and convenience and special purpose receptacles to show panel and circuit number to which the device is connected.
- C. Provide and install identification tags on all conduit pull.
- D. Provide label meeting ANSI Z535 standards on motors reading:

WARNING

AUTOMATIC EQUIPMENT

MAY START AT ANY TIME

3.10 CIRCUIT BREAKER ELECTRICAL COORDINATION STUDY

- A. Not used.

3.11 ARC FLASH STUDY

- A. Not used.

END OF SECTION

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SECTION 26 05 26
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Materials, equipment fabrication, installation and tests in conformity with equipment applicable to this project, applicable codes and authorities having jurisdiction, for grounding.

1.2 RELATED SECTIONS

- A. Requirements per the front-end bidding requirements and Section 0100 through 0200.10 inclusive.
- B. All included sections under Division 26
- C. Plans
- D. Manufacturers' manuals, product bulletins, etc.

1.3 REFERENCE STANDARDS

- A. Published specifications standards, tests or recommended methods of trade, industry or government organizations apply to work in this section as cited in Section 16000

1.4 QUALITY ASSURANCE

- A. Equipment and accessories shall be the product of a manufacturer regularly engaged in its manufacture.
- B. Supply equipment and accessories new, free from defects.
- C. Supply equipment and accessories in compliance with the applicable standards listed in Article 1.3 of this section and with applicable national, state and local codes.
- D. Items of a given type shall be the products of the same manufacturer.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01330. Provide detailed description of items supplied, including specifications, performance characteristics, materials, wiring diagrams and schedules.
 - 1. Submit evidence that products satisfy seismic requirements for the State of California.

2. Submit evidence of compliance with the applicable standards listed under Article 1.3 of this section.
 - B. Manufacturer's Instructions: Submit manufacturer's installation instructions.
 - C. Product Data: Submit manufacturer's descriptive literature.
 - D. Shop Drawings: Submit complete fabrication details, elevations and sections of switchboard, dimensions, space available for conduit, rating, short circuit withstand ability of bus and lowest rated device, circuit schedule showing circuit number, device description, device frame ampere rating and trip, fuse clip ampere rating, termination lug size, feeder and circuit identification, conductor ratings and one-line and wiring diagrams. Include both elementary diagram and terminal to terminal wiring diagrams.
 - E. Substitutions: Items of same function and performance shall be in conformance with Division 1.
 - F. Submit field test and operations check report for circuit breakers and motor starters under provisions of Section 16080.
- 1.6 OPERATION AND MAINTENANCE DATA
- A. Submit operation instructions, maintenance and repair data under provisions of Division 1.
 - B. Ship equipment in its original packages to prevent damaging or entrance of foreign matter. Perform handling and shipping in accordance with manufacturer's recommendations. Provide protective covering during construction.
 - C. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by the engineer.
 - D. Tag items with a weatherproof tag identifying equipment by name and purchase order number. Include packing and shipping lists.

PART 2 - PRODUCTS

2.1 GROUND RODS – NOT USED

2.2 BARE COPPER GROUND WIRE

- A. Conductors shall be medium-hard drawn, copper, and stranded, with sizes as shown on drawings or sized based on the circuit ampacity.

2.3 BELOW GRADE GROUND CONNECTIONS

- A. NOT USED

2.4 HARDWARE

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

PART 3 - EXECUTION

3.1 SYSTEM NEUTRAL GROUND

- A. NOT USED.
- B. NOT USED.

3.2 EQUIPMENT GROUND

- A. Ground non-current carrying metal parts of electrical equipment enclosures, frames, or conductor raceways to provide a low impedance path for line-to-ground fault current and to bond all non-current carrying metal parts together. Install a ground conductor in each raceway system. Equipment ground conductor shall be electrically and mechanically continuous from the electrical circuit source to the equipment to be grounded. Size ground conductors per CEC 250-95 unless otherwise shown on drawings.
- B. Grounding conductors shall be identified with green insulation. Where green insulation is not available, on larger sizes, black insulation shall be used and suitably identified with green tape at each junction box or enclosure device.
- C. Install metal raceway couplings, fittings and terminations secure and tight to insure good ground continuity. Provide grounding bushing and bonding jumper where metal raceway is not directly attached to equipment metal enclosure and at concentric knockouts.
- D. Lighting fixtures shall be securely connected to equipment ground conductors. Outdoor lighting standards shall have a factory installed ground for terminating the ground wire.
- E. Motors shall be connected to equipment ground conductors with a conduit grounding bushing and with a bolted solderless lug connection on the metal frame.

3.3 STRUCTURAL GROUND

- A. NOT USED
- B. NOT USED
- C. NOT USED

3.4 CIRCUIT BREAKER ELECTRICAL COORDINATION STUDY

- A. NOT USED.

B. NOT USED.

3.5 GROUND RESISTANCE TEST

A. NOT USED.

B. NOT USED.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers and supports for electrical equipment and systems.
- B. Construction requirements for concrete bases.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1
 - 1. Section 013000: Administrative Requirements
 - 2. Section 013300: Submittal Procedures
 - 3. Section 014000: Quality Requirements
 - 4. Section 016000: Product Requirements
 - 5. Section 017000: Execution and Closeout Requirements
 - 6. All other included sections under Division 1
- B. All included sections under Division 26
- C. All included sections under Division 27
- D. Plans
- E. Manufacturers' manuals, product bulletins, etc.

1.3 REFERENCE STANDARDS AND CODES

- A. Published specifications standards, tests or recommended methods of trade, industry or government organizations apply to work in this section as cited in Section 260000.
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36/A36M: Standard Specification for Carbon Structural Steel
 - 2. ASTM A167: Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - 3. ASTM A276: Standard Specification for Stainless Steel Bars and Shapes
 - 4. ASTM A325: Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength
 - 5. ASTM A563: Standard Specification for Carbon and Alloy Steel Nuts
 - 6. ASTM B221: Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - 7. ASTM B632: Standard Specification for Aluminum-Alloy Rolled Tread Plate

8. ASTM B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 9. ASTM E488: Standard Test Methods for Strength of Anchors in Concrete Elements
 10. ASTM F594: Standard Specification for Stainless Steel Nuts
- C. American Welding Society (AWS)
1. AWS D1.1: Structural Welding Code - Steel
- D. California Building Safety Codes (CBSC)
1. California Building Code (CBC).
 2. California Electrical Code (CEC)
- E. General Services Administration
1. FF-S325
 2. W-C-582: Conduit, Raceway, Metal and Fittings: Surface
 3. WW-H-171: Hanger and Support, Pipe
- F. ICC Evaluation Service (ICC-ES)
1. ESR-1917
- G. Manufacturers Standardization Society (MSS)
1. MSS SP-58: Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation
 2. MSS SP-69: Pipe Hangers and Supports – Selection and Application
- H. Metal Framing Manufacturers' Association
1. MFMA-4: Metal Framing Standard Publication
 2. MFMA-101: Guidelines for the Use of Metal Framing
- I. National Electrical Contractors Association
1. NECA 1: Standard Practice of Good Workmanship in Electrical Construction
 2. NECA 101: Standard for Installing Steel Conduits (Rigid, IMC, EMT)
- J. Underwriters' Laboratories
1. UL 2239: Hardware for the Support of Conduit, Tubing, and Cable
- 1.4 QUALITY ASSURANCE
- A. A.Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with latest editions of the California Building Code and California Electric Code
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 013000 or 013300.
- B. Submittals shall include the following:

1. Table of contents
 2. A complete set of detailed manufacturer's specifications describing and illustrating all standard and special components and materials
 3. Part numbers
 4. Evidence of compliance with the applicable standards listed under Article 1.3 of this section
 5. Maintenance instructions and intervals
 6. A complete set of drawings for any special items
- C. Electronic submittals shall be searchable
- D. Shop drawings shall be stamped and signed by a licensed structural engineer. Show fabrication and installation details and include calculations for the following:
1. Trapeze hangers: include product data for components
 2. Steel slotted channel systems: include product data for components
 3. Equipment supports
- E. Welding certificates
- F. The submittal shall be substantially complete for all items and equipment furnished under this section.
- G. Individual drawings and data sheets submitted at random intervals will not be accepted for review.
- H. Substitutions: Items of same function and performance shall be submitted in conformance with Division 1.
- 1.6 OPERATION AND MAINTENANCE MANUALS
- A. Submit manuals at close out.
- B. The manuals shall, at minimum, include the following:
1. Manufacturer (including contact information)
 2. Model number
 3. Load ratings
 4. Material type(s)
 5. Environmental ratings
 6. Maintenance requirements
 7. Installation instructions
 8. Repair instructions (where applicable)
- C. Provide manuals in one of the following formats.
1. Three hardcopies
 2. PDF

1.7 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems
 - 1. Comply with MFMA-4, factory-fabricated components for field assembly.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings:
 - a. PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - b. Minimum thickness shall be 40 mils.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
 - 6. Manufacturers:
 - a. Cooper B-Line, Inc.
 - b. ERICO International Corporation
 - c. Hilti Corporation
 - d. Thomas & Betts Corporation
 - e. Unistrut
 - f. Approved equal
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

- E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.

- F. Mounting, Anchoring, and Attachment Components:
 - 1. General:
 - a. Anchors shall be steel with corrosion resistant, durable coating or stainless steel
 - b. Select anchors with strength required for anchor and as tested according to ASTM E488.
 - c. Minimum length shall be eight times diameter.
 - d. Tension, shear, and pullout capacities shall be appropriate for supported loads and building materials used
 - e. Post installed anchors must be listed in a current evaluation report issued by one of the following:
 - 1) International Code Council Evaluation Service (ICC-ES)
(<http://www.icc-es.org/reports/index.cfm?search=search>)
 - 2) City of Los Angeles Research Report
 - 2. Powder-Actuated Fasteners:
 - a. Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood
 - b. Manufacturers:
 - 1) Hilti Corporation
 - 2) Simpson Strong-Tie Co., Inc.
 - 3) Approved equal
 - 3. Mechanical-Expansion Anchors:
 - a. Insert-wedge-type, stainless steel, for use in hardened portland cement
 - b. Anchors shall meet the descriptive part of Federal Specifications FF-S-325 Group II, Type 2, Class 2, Style 1.
 - c. Anchors shall be equivalent to Hilti Kwik-Bolt TZ.
 - 4. Concrete inserts shall be steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58
 - 5. Clamps for attachment to steel structural elements: MSS SP-58, type suitable for attached structural element
 - 6. Through bolts shall be structural type, hex head, high strength and comply with ASTM A325
 - 7. Toggle Bolts: All-steel springhead type
 - 8. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

- B. BMaterials:
 - 1. Comply with requirements with ASTM A36 (ferrous metals), ASTM A167 and ASTM A276 (stainless steel), and ASTM B221 and B632 (aluminum) for shapes and plates.
 - 2. Hot dipped galvanized steel
 - 3. Stainless steel for corrosive areas.

2.3 CONCRETE BASES

- A. Not used.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by California Electrical Code. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables:
 - 1. Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 2. Secure raceways and cables to these supports with two-bolt conduit clamps
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in California Electric Code.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (890 N).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code.
 - 1. Wood framing: Fasten with lag screws or through bolts.
 - 2. Light gauge steel framing: self tapping screws
 - 3. Steel beams: beam clamps
 - 4. Concrete: expansion fasteners

3.3 CONDUIT SUPPORTS

- A. Conduit supports
 - 1. For Individual conduit runs not directly fastened to the structure: Rod hangers
 - 2. For multiple conduit runs: Trapeze type conduit support designed for maximum loading deflection not exceeding manufacturer's recommendations.
 - 3. Wire or sheet metal strips are not acceptable for conduit not directly fastened to structure or for multiple conduit runs.
- B. Support conduit with Underwriters' Laboratories listed conduit support intervals required by the California Electric Code.
- C. Individual conduit 1/2 inch and 3/4 inch size may be supported from ceiling support wire with Caddy clips only if acceptable to local code. Only one conduit is permitted to be attached to any ceiling support wire. Hang such conduit so as not to affect level of ceiling.
- D. Avoid attaching conduit to fan plenums. When it is necessary to support conduit from fan plenum, provide a length of flexible conduit between the section attached to the fan plenum and other sections. Provide a length of flexible conduit between the portion attached to the building and the rest of the conduit run to minimize transmission of vibration to the building structure.
- E. Supports anchored to earth shall be anchored in a concrete base per details.

3.4 INSTALLATION OF POST-INSTALLED ANCHORS

- A. NOT USED

3.5 TESTING AND INSPECTION OF POST-INSTALLED ANCHORS

- A. NOT USED

3.6 PAINTING

- A. Touchup
 - 1. Clean field welds and abraded areas of shop paint.
 - 2. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting.
 - 3. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
 - 4. Comply with the following requirements
 - a. Architectural painting specifications
 - b. SSPC-PA 1 requirements for touching up field-painted surfaces.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTIONS INCLUDES

- A. Testing in conformity with equipment applicable to this project, applicable codes and authorities having jurisdiction
- B. Test equipment requirements listed in this section shall apply to testing required by all other sections in Division 26 and Division 27.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1
 - 1. Section 013000: Administrative Requirements
 - 2. Section 013300: Submittal Procedures
 - 3. Section 014000: Quality Requirements
 - 4. Section 016000: Product Requirements
 - 5. Section 017000: Execution and Closeout Requirements
 - 6. All other included sections under Division 1
- B. All included sections under Division 26
- C. All included sections under Division 27
- D. Plans
- E. Manufacturers' manuals, product bulletins, etc.

1.3 REFERENCE STANDARDS AND CODES

- A. Published specifications standards, tests or recommended methods of trade, industry or government organizations apply to work in this section as cited in Section 260000.
- B. California Electrical Code
- C. International Electrical Testing Association (NETA)
 - 1. NETA ATS: for Acceptance Testing Specifications for Electrical Power Equipment and Systems
- D. Institute of Electrical and Electronic Engineers
 - 1. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

2. IEEE 82: Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors
3. IEEE 95: Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors
4. IEEE 112: Standard Test Procedure for Polyphase Induction Motors and Generators
5. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
6. IEEE 241: Recommended Practice for Electric Power Systems in Commercial Buildings.
7. IEEE 242: Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book)
8. IEEE 259: Standard Test Procedure for Evaluation of Systems of Insulation for Dry-Type Specialty and General-Purpose Transformers
9. IEEE 393: Test Procedures for Magnetic Cores
10. IEEE 399: Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book)
11. IEEE 442: Guide for Soil Thermal Resistivity Measurements
12. IEEE 495: Guide for Testing Faulted Circuit Indicators
13. IEEE 576: Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications

E. National Institute of Standards and Technology (NIST)

F. Underwriters' Laboratories

1. UL 1244: Electrical and Electronic Measuring and Testing Equipment
2. UL 1436: Outlet Circuit Testers and Similar Indicating Devices
3. UL 61010-2-030: Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-030: Particular requirements for testing and measuring circuits
4. UL 61010B-1: Electrical Measuring and Test Equipment – Part 1: General Requirements
5. UL 61010B-2-031: Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2: Particular Requirements for Hand-Held Probe Assemblies for Electrical Measurement and Test
6. UL 61010B-2-032: Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2: Particular Requirements for Hand-Held Current Clamps for Electrical Measurement and Test

1.4 QUALITY ASSURANCE

- A. The Contractor shall engage and pay for the services of a recognized independent testing laboratory for the purpose of performing inspections and tests as herein specified.
- B. The testing laboratory shall provide all material, equipment, labor and technical supervision to perform switch tests and inspections.
- C. It is the intent of these tests to assure that all electrical equipment, both Contractor and Owner supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.

- D. The tests and inspections shall determine the suitability for energizing.
- E. Schedule tests and give a minimum of two weeks advance notice to the Owner.

1.5 SUBMITTALS

- A. List of tests performed
- B. Test procedures
- C. Test results
- D. The submittal shall be substantially complete for all items and equipment furnished under this section.
- E. Individual drawings and data sheets submitted at random intervals will not be accepted for review.

1.6 QUALIFICATIONS OF TESTING AGENCY

- A. The testing agency shall meet federal OSHA criteria for accreditation of testing laboratories, Standard Number 1910.7 (Definition and Requirements for a nationally recognized testing laboratory). International Electrical Testing Association (NETA) accreditation constitutes proof of meeting such criteria.

1.7 TEST INSTRUMENT TRACEABILITY

- A. The testing laboratory shall have a calibration program which maintains all applicable test instrumentation within rated accuracy.
- B. The accuracy shall be traceable to the National Institute of Standards and Technology (NIST) in an unbroken chain.
- C. Instruments shall be calibrated in accordance with the following frequency schedule:
 - 1. Field instruments: 6 months maximum.
 - 2. Laboratory instruments: 12 months.
 - 3. Leased specialty equipment: 12 months
- D. Dated calibration labels shall be visible on all test equipment.

1.8 FINAL SETTINGS

- A. The test report shall include the following: summary of project, description of equipment tested, description of test, list of test equipment used in calibration and calibration date, test results, conclusions and recommendations, and appendix, including appropriate test forms.
- B. The test report shall be bound and its contents certified.

- C. Submit three copies of the completed report to the architect, or engineer if no architect is involved, no later than fifteen (15) days after completion of test, unless otherwise directed.

1.9 FAILURE TO TEST

- A. Any system material or workmanship which is found defective on the basis of acceptance tests shall be reported directly to the architect or engineer if no architect is involved.
- B. Contractor shall replace the defective material or equipment and have test repeated until test proves satisfactory without additional cost to the Owner.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GROUND RESISTANCE TEST

- A. Not used.

3.2 MISCELLANEOUS TESTING

- A. Not used.

3.3 ELECTRICAL DISTRIBUTION EQUIPMENT OPERATIONAL CHECK

- A. Electrical distribution equipment operational check includes main switchboards, distribution boards, panelboards, panels, switchgear, etc.
- B. Verify proper operating condition of all equipment mechanically and electrically including, but not limited to verifying operation of each circuit breaker trip device with a rating of 100A or more using an accurately metered timed instrument (by passing 300% rated current through each pole).
- C. If any equipment is found defective during operational check, it shall be replaced by the Contractor without cost to the Owner. The tests shall be repeated by the Contractor without cost to the owner until satisfactory results are obtained.

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section includes materials, equipment fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction, for lighting fixtures and installation.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1
 - 1. Section 013000: Administrative Requirements
 - 2. Section 013300: Submittal Procedures
 - 3. Section 014000: Quality Requirements
 - 4. Section 016000: Product Requirements
 - 5. Section 017000: Execution and Closeout Requirements
 - 6. All other included sections under Division 1
- B. All included sections under Division 26
- C. Plans
- D. Manufacturers' manuals, product bulletins, etc.

1.3 REFERENCE STANDARDS AND CODES

- A. Published specifications standards, tests or recommended methods of trade, industry or government organizations apply to work in this section as cited in Section 260000.
- B. NFPA 70 - National Electrical Code
- C. Illuminating Engineering Society: The Lighting Handbook
- D. Underwriters' Laboratories
 - 1. UL 50: Enclosures for Electrical Equipment, Non-environmental Considerations
 - 2. UL 50E: Enclosures for Electrical Equipment, Environmental Considerations
 - 3. UL 496: Lampholders
 - 4. UL 542: Fluorescent Lamp Starters
 - 5. UL 844: Standard for Luminaires for Use in Hazardous (Classified) Locations
 - 6. UL 924: Emergency Lighting and Power Equipment
 - 7. UL 935: Fluorescent Lamp Ballasts
 - 8. UL 1029: High Intensity Discharge Lamp Ballasts
 - 9. UL 1029A: Igniters and Related Auxiliaries for HID Lamp Ballasts

10. UL 1149: Standard for Low Voltage Marine Lighting Fixtures
11. UL 1196: Standard for Floating Waterlights
12. UL 1573: Stage and Studio Luminaires and Connector Strips
13. UL 1574: Track Lighting Systems
14. UL 1598: Luminaires
15. UL 1598B: Standard for Supplemental Requirements for Luminaire Reflector Kits for Installation on Previously Installed Fluorescent Luminaires
16. UL 1598C: Light Emitting Diode (LED) Retrofit Luminaire Conversion Kits
17. UL 1680: Stage and Lighting Cables.
18. UL 1838: Low Voltage Landscape Lighting Systems
19. UL 2007A: Shatter Containment Of Lamps For Use In Regulated Food Establishments
20. UL 2108: Low Voltage Lighting Systems
21. UL 2388: Standard for Flexible Lighting Products
22. UL 2575: Standard for Lithium Ion Battery Systems for Use in Electric Power Tool and Motor Operated, Heating and Lighting Appliances
23. UL 8750: Light Emitting Diode Equipment for Use in Lighting Products
24. UL 60730-2-3: Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Thermal Protectors for Ballasts for Tubular Fluorescent Lamps.

1.4 QUALITY ASSURANCE

- A. Equipment and accessories shall be the product of a manufacturer regularly engaged in its manufacture.
- B. Supply equipment and accessories new, free from defects.
- C. Supply equipment and accessories in compliance with the applicable standards listed in Article 1.3 of this section and with applicable national, state and local codes.
- D. Items of a given type shall be the products of the same manufacturer.
- E. Ship equipment in its original packages to prevent damaging or entrance of foreign matter. Perform handling and shipping in accordance with manufacturer's recommendations. Provide protective covering during construction.
- F. Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by the engineer.
- G. Tag items with a weatherproof tag identifying equipment by name and purchase order number. Include packing and shipping lists.

1.5 SUBMITTALS

- A. Submit under provisions of Section 013000 or 013300.
- B. Submittals shall include the following:
 1. Table of contents

2. A complete set of detailed manufacturer's specifications describing and illustrating all standard and special components and materials
 3. Part numbers
 4. Evidence of compliance with the applicable standards listed under Article 1.3 of this section
 5. Maintenance instructions and intervals
 6. Calibration procedures and intervals
 7. A complete set of drawings for any special items
 8. Wiring diagrams
 9. Drawings shall include designations, dimensions, operating controls, instruments, riser diagrams, routing diagrams etc.
- C. Electronic submittals shall be searchable
- D. The submittal shall be substantially complete for all items and equipment furnished under this section.
- E. Individual drawings and data sheets submitted at random intervals will not be accepted for review.
- F. Substitutions: Items of same function and performance shall be submitted in conformance with Division 1.
- G. Pole mounted fixtures, including complete data on the pole material, finish, handholes, anchoring and attachment. Support method shall be submitted for interior fixtures weighing more than fifty (50) pounds.
- 1.6 OPERATION AND MAINTENANCE MANUALS
- A. Submit operation and maintenance manuals in accordance with Section 260000.
- B. The manuals shall, at minimum, include the following:
1. Manufacturer (including contact information)
 2. Model number
 3. Programming manual (where applicable)
 4. Wiring diagrams
 5. Trouble-shooting guidelines (where applicable).
 6. Voltage ratings
 7. Current ratings
 8. Calibrated range (where applicable)
 9. List of capabilities
 10. Environmental ratings
 11. NEMA enclosure type
 12. Maintenance requirements
 13. Installation instructions
 14. Repair instructions (where applicable)
- C. Provide manuals in one of the following formats:
1. Three hardcopies
 2. PDF

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish and install all fixtures complete, including lamps, ballasts, whips, conductors, etc. and ready for service.
- B. Fixture Designation: Fixtures are designated on Drawings by means of letters. See Lighting Fixture Schedule. Where only one (1) fixture designation appears in a room or area, that designation applies to all fixtures in that room or area.
- C. Tandem wired units acceptable where appropriate.
- D. Manufacturers and models for fixtures, ballasts, and lamps shall be as shown on the fixture schedule or approved equal.

2.2 FIXTURES

- A. Linear Fixtures:
 - 1. Fixture housings shall be steel.
 - 2. Housing shall be painted after fabrication with white, electro-statically deposited paint. Housing shall be completely covered with paint to prevent corrosion.
- B. All lenses shall be clear, prismatic, 0.125", K12 pattern, acrylic lenses.
- C. Louvers shall be semi-specular aluminum.
- D. Open can light reflectors shall be semi-specular aluminum.
- E. Fixtures installed in gyms and similar rooms, locker rooms, storage rooms, and warehouses shall include stainless steel wireguards to protect fixture from damage.
- F. Fixtures shall direct a minimum of 75% of light within zone below 30 degrees below horizontal.

2.3 EXIT SIGNS

- A. All exit signs shall be connected to an unswitched source.
- B. Colors
 - 1. Face shall be white.
 - 2. Letters and arrows shall be green.
- C. Exit signs shall have arrows to indicate direction of exit where necessary.
- D. All exit signs shall include batteries to provide 90 minutes of illumination in the event of a power outage.

2.4 FIXTURE HANGERS AND SUPPORTS

- A. Provide proper supports and mounting accessories, such as hangers, stems, yokes, plaster frames, etc., as required by the type of ceiling installed.
- B. Where pendant mounted fixtures with stems are specified, provide swivel canopies or ball aligners in order to hang plumb regardless of ceiling slope.
- C. Entire assemblies shall comply with state earthquake resistance/ bracing guidelines.

2.5 GROUNDING

- A. All fixtures shall be grounded.

2.6 LIGHTING CONTROLS

- A. Refer to plans.

PART 3 - EXECUTION

3.1 GENERAL

- A. Verify ceiling type and conditions. Order fixtures designed for conditions and the type of ceiling installed.
- B. Architectural reflected ceiling plans shall be used to determine exact locations of lighting fixtures.
- C. Determine exact location and height of fixtures by the structural and mechanical limitations of the building. Install fixtures in such a manner as to avoid such obstructions and to give proper illumination result. Verify layouts with architect.
- D. All recessed lighting fixtures shall be wired from adjacent junction boxes utilizing 6' flexible metal conduit to permit future fixture relocation. Outlet box for surface or stem mounted fixtures shall be provided with fixture stud as well as tapped and drilled canopy covers. All outlets shall finish flush with walls or ceiling except where in ceiling tiles, locate these in the center of a tile or at the intersection of four (4) tiles.
- E. All building mounted fixtures shall be supported from the building structural members. Provide all necessary blocking and hardware so that fixtures installed suspended below grid type ceiling shall be supported independently of the grid system at a minimum of four (4) points per 4' long fixture.
- F. Minimum mounting provisions for closed ceiling (surface) mounted fluorescent lighting fixtures in ceilings other than grid type shall be as follows:
 - 1. 4' long fixture body: By a pair of 3/8" machine bolts separated by a maximum distance possible and located 4 inches in from each end of fixture - total of four (4) bolts per fixture.

- G. Support for fixtures installed in suspended ceilings shall conform to Section 4701 of Title 24, Part 2.
- H. When installed in grid type ceiling, a slack #12 gauge galvanized tie wire permanently attached to the structure shall be provide at four (4) corners of each 4' long fixture.
- I. At fire rated ceiling, provide sheet rock at top and at all sides of recessed mounted lighting fixtures.
- J. Ground all fixtures.

END OF SECTION

SECTION 27 15 13

COMMUNICATIONS HORIZONTAL TWISTED PAIR CABLING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Horizontal Twisted Pair Cabling
- B. Related Sections
 - 1. Comply with the Related Sections requirements of Section 270000
 - 2. 270811 Communication Twisted Pair Testing
 - 3. 271313 Communication Backbone Twisted Pair Cabling

1.02 REFERENCES

- A. Comply with the References requirements of Section 270000.
- B. In addition to the codes and standards listed in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. National Fire Protection Agency (NFPA)
 - a. NFPA 255, "Standard Method of Test of Surface Burning Characteristics of Building Materials", 2006
 - b. NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces", 2007
 - 2. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 444, "Communications Cables"
 - b. UL 497, "Protectors for Paired-Conductor Communication Circuits"
 - c. UL 1581, "Reference Standard for Electrical Wires, Cables, and Flexible Cords"
 - d. UL 1863, "Communications-Circuit Accessories"
 - 3. Insulated Cable Engineers Association (ICEA):
 - a. ICEA S-102-700-2004, "ICEA Standard For Category 6 Individually Unshielded Twisted Pair Indoor Cables (With Or Without An Overall Shield) For Use In Communications Wiring Systems Technical Requirements"

1.03 DEFINITIONS

- A. Refer to Section 270000 for Definitions.
- B. In addition, define the following list of terms as used in this specification as follows:
 - 1. "CAT6A": Category 6 Augmented [UTP] performance grade
 - 2. "Channel": End to end transmission path; e.g., the entire portion of the horizontal cabling to each outlet consisting of the Permanent Link, line cord (at the workstation), patch cord, and, if a full crossconnection is implemented, the crossconnect termination/connecting apparatus and equipment cord.
 - 3. "CMP": Communications Media Plenum [NEC plenum rating]
 - 4. "CMR": Communications Media Riser [NEC riser {non-plenum} rating]
 - 5. "FEP": Fluorinated Ethylene Propylene
 - 6. "PE": Polyethylene
 - 7. "Permanent Link": Test configuration for a horizontal cabling link excluding patch cords, equipment cords, and line cords; e.g., the 'permanent' portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used), termination/connecting apparatus in the telecommunications and the connector at the outlet.
 - 8. "PVC": PolyVinyl Chloride
 - 9. "UTP": Unshielded Twisted Pair

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

- 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.05 SYSTEM DESCRIPTION

A. Work Covered Under Other Sections

- 1. Pathways: The communications pathways (basketway, conduits, stubs, etc.) work will be covered under another Section.
- 2. Rooms: Build out (e.g., backboards, overhead and vertical cable runway, etc.) of the telecommunications rooms will be covered under another Section.

B. Base Bid Work

- 1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working communications Horizontal Twisted Pair Cabling System installation described in this Section and shown on related Drawings. Consider Horizontal Cabling as shown on Drawings as base bid work, unless otherwise noted. This includes terminations at both ends.
- 2. In general, the base bid work includes:
 - a. Submittals
 - b. Horizontal cables, terminations, and outlets
 - c. Cable management
 - d. Patch cords and crossconnections

- e. Cable identification tags and system labeling
- f. Record Documents
- g. Warranty

1.06 SUBMITTALS

- A. Comply with the Submittals article of Section 270000 for procedural, quantity, content, and format requirements.
- B. Substitutions
 - 1. Conform to substitutions requirements and procedure in Section 270000.
- C. Submittal Requirements at Start of Construction:
 - 1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
 - 2. Sample Submittal, consisting of the following components:
 - a. Type "A" Outlet Sample – one fully configured outlet including faceplate, modular jacks, and label
 - b. Cable Label Sample
 - c. In lieu of a physical example, the Engineer will accept clear in-focus electronic images showing various views.
 - 3. WAP Outlet Layout
 - a. Coordinated ceiling plan showing the layout of WAP type outlets in the ceiling in relation to ceiling tiles and other visible components, such as sprinklers, speakers, lighting, etc.
 - b. Locate outlets in an evenly grid with outlet quantities shown on the Drawings.
 - c. Submit to Architect (design team) and to the University for review and approval.
 - 4. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations. If the contractor does not propose any changes, the Engineer does not require shop drawings.
- D. Submittal Requirements at Closeout:
 - 1. As-Built Drawings
 - 2. Cable ID –to– Office Number Key: Submit a "cable ID-to-Office number key" as an electronic file in an MS-Excel spreadsheet file format containing a list of every cable identifier associated with the final office number
 - 3. Crossconnection records/cut sheets
 - 4. O & M Manuals
- E. Posted Documentation
 - 1. Post one full size plot of as-built drawings, specifically the floor plans and (as applicable) reflected ceiling plans, within TRs such that show the TR's serving area. Coordinate

wall location with other equipment as shown on the Drawings..

1.07 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of Section 270000.
- B. Contractor Qualifications
 - 1. In addition to the Contractor Qualifications requirements of Section 270000, the Contractor shall be certified by the manufacturer to provide the cabling system (proposed, submitted, and approved) and to provide an extended warranty. Submit satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Delivery, Storage and Handling requirements of Section 270000.

1.09 WARRANTY

- A. The horizontal cabling system, as specified in this section, shall carry a 15-year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover electrical performance of cabling system to the specific category per ANSI/TIA/EIA-568-C performance criteria for horizontal cabling.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide a complete system structured cabling including cable and connectivity to provide an overall warranted CAT6A system solution.
- B. Manufacturers listed in alphabetic order and not in order of preference.
- C. Approved Systems:
 - 1. Berk-Tek LANmark-10G2 UTP / Leviton eXtreme 6A Connectivity
 - 2. Panduit TX6A 10GIG UTP
 - 3. Superior Essex 10Gain / Ortronics Clarity 10G Connectivity
 - 4. SYSTIMAX GigaSPEED X10D UTP / SYSTIMAX 360 Connectivity

2.02 HORIZONTAL CABLE – CAT6A PLENUM (CMP) RATED

- A. Application: Suitable for indoor installation, within ceiling space in primary and secondary pathways.

B. Conductors:

1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = FEP, or equivalent).
2. Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair) with individually color-coded twisted pairs to industry standards (ANSI/ICEA Publication S-80-576-1994, and EIA-230).

C. Cable Sheath:

1. Outer Jacket: seamless outer jacket (material = LS-PVC, or similar) applied to and completely cover the internal components (twisted pairs).
2. Flame Rating: NEC (Article 800) rated as CMP, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-C.2, ISO 11801 Class E Edition 2.1, and IEEE Std. 802.3an channel requirements for supporting 10GBASE-T.

E. Jacket Color: Blue

F. Manufacturer: Refer to paragraph 2.1

2.03 HORIZONTAL SINGLE-ENDED CORD – CAT6A PLENUM (CMP) RATED

A. Application: Suitable for indoor installation, within access/raised floor space.

B. Cords assembled from a single, continuous length of cordage, homogenous in nature, and terminated at one end via 8 position modular plugs. Splices are not permitted anywhere.

C. Cordage / Cable

1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = FEP, or equivalent).
2. Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair), and individually color coded.
3. Unshielded sheath and flame-retardant polyvinyl chloride (PVC) jacketed.
4. Flame Rating: NEC (Article 800) rated as CMP, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-B.2-AD10, ISO 11801 Class E Edition 2.1, and IEEE Std. 802.3an latest draft proposal channel requirements for supporting 10GBASE-T.

E. Manufacturer: Refer to paragraph 2.1

2.04 HORIZONTAL CABLE – CAT6 OSP/UNDERGROUND

A. Application: Suitable for outdoor installation, within underground pathways (conduit, pullboxes).

B. Conductors:

1. Insulated Conductors: 23 AWG solid copper, fully insulated with a thermoplastic material (material = PE, or equivalent).
2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair) with individually color-coded twisted pairs to industry standards (ANSI/ICEA Publication S-80-576-1994, and EIA-230).

C. Core & Sheath:

1. Twisted pairs shall lie individually within a polyolefin fluted center member.
2. Filled: Cable core and sheath flooded with filling compound to protect against moisture penetration. Filling compound: “FLEXGEL”, or equivalent.
3. Outer Jacket: seamless outer jacket (material = PE, or similar) applied to and completely cover the internal components (twisted pairs), embedded with UV inhibitors, and black in color.

D. Electrical Performance: Meet or exceed ANSI/TIA-568-C.2 and ISO/IEC 11801 requirements for CAT6 UTP cabling.

E. Manufacturer: Refer to paragraph 2.1

2.05 MODULAR PATCH CORDS – CAT6A RATED

A. Application: Suitable for indoor installation within a telecommunications room or workstation environment.

B. Cords assembled from a single, continuous length of cordage, homogenous in nature, and terminated at both ends via 8 position modular plugs. Splices are not permitted anywhere.

C. Cordage

1. Insulated Conductors: 26AWG stranded copper, fully insulated with a flame retardant thermoplastic material (such as PVC, or equivalent).
2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair), and individually color coded.
3. Unshielded sheath and flame-retardant polyvinyl chloride (PVC) jacketed.
4. Flame Rating: NEC CM (or higher) rated, and UL listed as such.

D. Electrical Performance: Meet or exceed ANSI/TIA-568-C.2 and ISO/IEC 11801 requirements for CAT6A UTP cabling.

E. Length: Refer to the Drawings

F. Jacket Colors: Refer to the Drawings

G. Manufacturer: Refer to paragraph 2.1

2.06 TERMINATION APPARATUS – MODULAR PATCH PANEL, CAT6A RATED

- A. Application: Panels shall be suitable for installation within a telecommunication room
- 99% CONSTRUCTION DOCUMENTS COMMUNICATIONS HORIZONTAL TP CABLING
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for the termination of the horizontal cables specified herein. Panels shall be horizontally oriented for a rack-mounted configuration. Panels shall be capable of supporting, organizing, labeling and patching/ crossconnecting between the horizontal termination field and the equipment termination field.

- B. Modular patch panel shall have 110-type termination, and shall be compatible with the specified horizontal cables both electrically and physically.
- C. Mechanical Performance: Each port shall be an 8-position modular jack, compliant to ANSI/TIA-568-C.2 (2 5.7).
- D. Electrical Performance: Each port shall meet or exceed TIA/EIA-568-C.2 6.8 and ISO/IEC 11801 requirements for CAT6A UTP cabling through the cable termination and patch cord connection.
- E. Wiring: Modular connectors shall be T568A wired.
- F. Manufacturer: Refer to paragraph 2.1

2.07 BEP PROTECTOR – FOR DATA CIRCUITS

- A. Application: Protectors suitable for installation within a telecommunication facility for the termination of the Horizontal OSP/Underground cables intended for data circuits.
- B. Protector shall be UL 497 listed.
- C. Solid-state protection with clamping voltage of 16VDC.
- D. Protector shall have a 4-pair capacity (minimum) with 110-type input and 110-type output
- E. Manufacturer: CommScope SYSTIMAX or equal
 - 1. #760028373; OSP protector, CAT6 rated, 2-cable capacity
 - 2. #760033951; OSP protector, CAT6 rated, for PoE circuits, 2-cable capacity

2.08 BEP PROTECTOR – FOR ANALOG VOICE CIRCUITS

- A. Application: Protectors suitable for installation within a telecommunication facility for the termination of the Horizontal OSP/Underground cables intended for analog (voice) circuits.
- B. Protector shall be UL 497 listed.
- C. Solid-state protection with clamping voltage of 235VDC.
- D. Protector shall have a 4-pair capacity (minimum) with 110-type input and 110-type output
- E. Manufacturer: CommScope SYSTIMAX or equal
 - 1. #760031708; OSP protector, CAT6 rated, for analog voice circuits, 2-cable capacity.

2.09 HORIZONTAL CABLE SUPPORT BAR

- A. Application: Suitable to support horizontal cables behind patch panels from vertical cable managers to termination point.
- B. Color: Match rack.
- C. Manufacturer: CPI or equal
 - 1. #12176-701

2.10 MODULAR CONNECTOR / 8-POSITION JACK – CAT6A RATED

- A. Application: Modular connectors (jacks) for termination of 4-pair UTP cables; modular connectors shall be compatible with the 4-pair cables specified herein this section both electrically and physically.
- B. Mechanical Performance: Modular jacks shall be 8-position, compliant to ANSI/TIA-568-C.2.
- C. Electrical Performance: Each jack shall meet or exceed TIA/EIA-568-C.2 and ISO/IEC 11801 requirements for CAT6A UTP cabling.
- D. Wiring: Modular connectors shall be T568A wired.
- E. Color: Refer to the Outlet Schedule on the Drawings for connector color requirements
- F. Manufacturer: Refer to paragraph 2.1

2.11 WORK AREA OUTLETS

- A. Faceplates for Standard Flush-Mount Outlets
 - 1. Application: Faceplates shall be suitable for indoor installation for standard 1-gang and 2-gang flush-mount devices.
 - 2. Faceplates shall have quantity of ports as identified in the Drawings, and shall include required accessories, such as icons, blank inserts, label windows and labels.
 - 3. Color: White
 - 4. Sizes: Refer to the Outlet Schedule on the Drawings (range from 1-port to 6-port positions)
 - 5. Manufacturer: Refer to paragraph 2.1
- B. Faceplate for Wall Phone Outlets
 - 1. Application: Faceplates shall be suitable for indoor installation for standard 1-gang flush-mount devices for standard wall-mount telephones.
 - 2. Faceplates shall include required accessories, such as icons, blank inserts, label windows and labels.
 - 3. Color: White
 - 4. Manufacturer: Refer to paragraph 2.1

C. Faceplates for Modular Furniture Mount Outlets

1. Four port faceplate/insert for modular furniture that fits into modular furniture selected for the project by owner.
2. Color: Coordinate color with owners' furniture planner
3. Manufacturer: Refer to paragraph 2.1

D. Surface Outlet Boxes

1. Application: Surface outlets shall be suitable for indoor installation for surface-mount device and shall be fully compatible with the specified modular connectors/jacks.
2. Color: White
3. Sizes: Refer to the Outlet Schedule in the Drawings (typically 2-port boxes)
4. Manufacturer: Refer to paragraph 2.1

E. "Poke-Thru" and Floorbox Outlets

1. Adapters that are fully compatible with both the "poke-thru" and "floorbox" type outlets and the specified connectors / connector accessories selected for the project.
2. Manufacturer: Refer to paragraph 2.1 and Wiring Devices specified in Division 26

F. Faceplates for Furniture Feeds

1. Application: Suitable for indoor installation for standard 1-gang flush-mount device box with round opening allowing cables to freely exit (towards furniture system entry).
2. Color: White
3. Manufacturer: Leviton or equal
 - a. # 80704-4; faceplate with 1.4" round opening

2.12 LABELS

A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.

B. Labels for Horizontal Cables

1. Adhesive backed labels and self-laminating feature.
2. Fit the horizontal cables listed above (i.e., shall fully wrap around the cable's jacket).
3. Size: 2"x.05" printable area, minimum
4. Color: white
5. Manufacturer: Panduit or equal
 - a. #S100X150YAJ; labels for cable diameters 0.16"-0.32", white, desktop printer (laser or ink jet)

2.13 VELCRO CABLE TIES

1. Width: .75".

- a. Color: Black
- b. Manufacturers: Panduit "Tak-Ty" series cable ties, or equal
- c. #HLS-15R-0; black, 15' roll, cut to length.

2.14 PLENUM CABLE TIES

1. Application: for use in plenum or air handling spaces
2. Color: maroon or other distinctive non-white color
3. Manufacturer: Panduit or equal
 - a. #PLT1M-xxxx
 - b. #PLT2S-xxxx
 - c. #PLT3S-xxxx

PART 3 - EXECUTION

3.01 GENERAL

- A. Comply with the Execution requirements of Section 270000.

3.02 EXAMINATION AND PREPARATION

- A. Rooms: Prior to installation, verify equipment rooms are suitable to accept the horizontal cables and terminations.
- B. Pathways: Prior to installation verify that pathways and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, "True Tape" the conduits).
- C. Cable Integrity: Prior to installation, verify the cable's integrity – both sheath and conductors.

3.03 INSTALLATION

A. Cable Installation and Routing

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
2. Place cables within designated pathways, such as cable tray, basketway, cable hangers, etc. Do not fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc), other systems (such as ceiling support wires, wall studs, etc), or to the outside of conduits, cable trays, or other non-approved pathway systems.
3. Place and suspend cables and conductors during installation and termination in a manner to protect them from physical interference or damage. Place cables

- with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.
4. No cable length shall exceed 90 meters from the termination point in the TR to the termination point at the work area (permanent link).
 5. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.
 6. Do not exceed manufacturer's limits for pulling tension.
 7. Do not use cable-pulling compounds for indoor installations.
 8. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.
 9. Route cables under building infrastructure (such as ducts, pipes, conduits, etc); Do not route cables over building infrastructure. The installation shall result in easy accessibility to the cables in the future.
 10. Place cables 6", minimum, away from power sources to reduce interference from EMI.
 11. Place a pull string along with cables where run in pathways and spare capacity in the pathway remains. Tie off ends of the pull string (to prevent the string from falling into the conduit).
 12. Neatly dress and organize cables using designated cable routing facilities.
 13. When exiting the primary pathway (such as cable tray) to the work area, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

B. Cable Routing and Dressing within the Telecommunications Room

1. Place cables within the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on-center using cable ties.
2. At the rack bay, route cables into the back of the vertical management sections. Divide the cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination. Do not route cables down the front side of the vertical cable manager (front side reserved for patching only).
3. Do not provide horizontal cable slack. Cut cables to exact length required to reach the termination apparatus. Do not use the vertical cable manager to store any horizontal cable slack.

C. Termination in the Telecommunications Room

1. Provide termination apparatus and accessories required for a complete installation. Install and assemble termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.
2. Properly strain relieve cables to and at termination points per manufacturer's instructions.
3. For OSP cables, apply sealant (such as B-sealant) to the end of the cable where the pairs exit the jacket – this step to seal the end of the cable and prevent water-blocking gel from leaking of the cable's sheath.
4. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and ANSI/TIA-568-C.0 standard installation practices. Terminate cable pairs onto the termination apparatus. Terminate twisted pairs compliant to T568A wiring, per ANSI/TIA-568-C.0.
5. Modular Patch Panels and Horizontal Management Panels

- a. Provide quantity of modular patch panels to support termination of cables served from respective Telecommunications Room as shown on Drawings. Provide quantity of horizontal management panels as shown on Drawings.
- b. Install and assemble modular patch panels and horizontal management panels according to the manufacturer's instructions.
- c. Install the patch panels and the horizontal management panels as shown on the Drawings.

6. Termination Sequence

- a. Terminate the cables in sequential order using the link's identifier starting at the top left and completing a panel before moving to the next panel below.

D. Cable Routing and Dressing at the Work Areas

1. Provide 10 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack within ceiling space neatly on a cable hanger.
2. Routing to Furniture-Mount Faceplates
 - a. Route cables from primary or secondary pathway within ceiling through the furniture-feed pathway (stub within wall) into opening at bottom of furniture. Exercise caution to prevent scraping, cutting, or other damage to cable's jacket.
 - b. Provide spiral wrap around cables from furniture-feed pathway to point where cables enter furniture.

E. Termination at the Work Areas

1. Provide device components, connectors, and accessories required for a complete installation. Install and assemble connectors, jacks, adapters, termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.
2. Provide six inches, minimum, sheathed cable slack behind each workstation outlet faceplate. Coil the slack cable inside the raceway, within the wall, or in the junction box (if used), per the cabling manufacturer's installation standards.
3. Wall-Mount Faceplates
 - a. Install devices at heights shown on the Drawings.
 - b. Mount faceplates plumb, square, and at the same level as adjacent device faceplates.
 - c. Patch gaps around faceplates so that faceplate covers the entire opening.
4. Furniture-Mount Faceplates
 - a. Coordinate installation of faceplate adapters with the furniture contractor, including color.
 - b. Mount faceplate adapters into the designated opening for telecommunications cabling.

5. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and ANSI/TIA-568-C.0 standard installation practices. Terminate cable pairs onto the connector compliant to T568A wiring, per ANSI/TIA-568-C.0.

F. Entrance Protector (for OSP/Underground Installation)

1. Provide protectors and accessories required for a complete installation.
2. Install the termination blocks in the wall space as shown on the Drawings.
3. Mount blocks plumb and square.

G. Perform post-installation testing as described in the Telecommunication Testing specification (refer to Section 270811). Replace terminations and connectors not passing the required media test.

H. Patching and Crossconnecting

1. In the Telecommunications Rooms, provide modular patch cords as shown on Drawings for network service
2. Neatly dress patch cords within the horizontal and vertical management components. Store cord slack within the vertical management section.

3.04 LABELING

A. General Requirements

1. Labeling, identifier assignment, and label colors shall conform to ANSI/TIA/EIA-606-A Administration Standard and as approved by the Engineer via the Submittal process before installation.
2. Permanent labels with machine-generated text (hand written labels will not be accepted).

B. Label Formats

1. Horizontal Cable Labels

- a. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
- b. Install labels on both ends of cables no more than 4" from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

2. Patch Panel Labels

- a. Use modular patch panel labels included in the product packaging. Request approval by the Engineer for other labels.
- b. Use a label color for the respective field type, per TIA/EIA-606.
- c. Text Attributes: Black, 3/32" high, minimum, or #10 font size.

3. Termination Block Labels

- a. Use labels included in the product packaging. Any deviation from this requirement must be approved in writing by the Engineer.
- b. Use a label color for the respective field type, per TIA/EIA-606-A.
- c. Text Attributes: Black, 3/32" high, minimum, or #10 font size.

4. Outlet Labels (Room Numbers)

- a. Use outlet labels included in the product packaging. Any deviation from this requirement must be approved in writing by the Engineer.
- b. Label Background: White.
- c. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
- d. Install label in the top label window.

C. Identifier Assignment

- 1. General: Separate label fields of the identifier with a hyphen.
- 2. Horizontal Cables

- a. Refer to the Drawings for format requirement and examples.

3. Outlets

- a. Refer to the Drawings for format requirement and examples.

4. Network Access Module (NAM) Designators

- a. Refer to the Drawings for format requirement and examples.
- b. Refer to chart below for NAM starting numbers and skip sequencing requirements between floors.

Level	"Data" Starting NAM ID	"Data" Last NAM ID	"Voice" Starting NAM ID	"Voice" Last NAM ID
First Floor	7000 0	as assigned	2000 0	as assigned
Second Floor	First Floors' last NAM ID +200	as assigned	First Floors' last NAM ID +200	as assigned
Third Floor	Second Floors' last NAM ID +200	as assigned	Second Floors' last NAM ID +200	as assigned

5. Individual Termination Positions at Termination Blocks

- a. Refer to the Drawings for format requirement and example.

6. Individual Ports at Patch Panels

- a. Refer to the Drawings for format requirement and example.

3.05 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 270000.

- 1 Remove cables and replace with new those failing to meet the indicated standards and not passing the testing requirements of Section 270811 with no impact to cost and schedule. The Owner, will not accept the installation until testing has indicated a 100% availability of all cables and conductors. Any deviation from this requirement must be approved in writing by the Owner.
- 2 Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION

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SECTION 27 4116

INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This specification section defines certain audio, audiovisual, and television systems to be installed by an audiovisual systems contractor. Please see Systems Descriptions for specifics.

1.01 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.02 SUMMARY

- A. Provide turnkey audiovisual systems, to include equipment and materials, whether specifically mentioned herein or not, to ensure complete and operating systems.
- B. Delivery of the work described in this Specification shall include, but not be limited to, the following Basic Services:
 - 1. Engineering and Design: Provide all system engineering and design necessary to develop the complete systems described herein. Engineering and Design shall include preparation of all necessary electronic schematics, hardware drawings, systems diagrams, schedules and lists. Additionally, final system design and configuration with the Owner, as well as on site audiovisual coordination and infrastructure installation review with the General Contractor is required.
 - 2. Assembly: Procure and assemble all hardware and equipment and any additional materials as required to deliver completely functioning Audiovisual Systems.
 - 3. Software Programming: Perform all required software setup, configuration, and programming required to develop a complete operating system in accordance with this Specification, including all control logic and push button component faceplate or interface programming. Control system to match existing University standard UI and minimum functionality requirements. Coordinate with University IT representative. Refer to Section 27 41 17 for detailed requirements.
 - 4. Submittal Information: Provide documents for the complete fabrication, installation and wiring of the systems. Provide (or sub-contract for) on-site installation and wiring, and provide on-going supervision and coordination during implementation.
 - 5. Installation: Install all equipment, cable, wiring, connectors, plates and other material at the Project site per the Integrator's approved designs. Install any owner furnished equipment

identified in this document and calibrate it to work with the integrated systems.

6. Coordination: Provide coordination required with the project teams to fulfill the scope of work defined herein to deliver the scope as defined in the contract document. To include though not be limited to:
 - a. Coordinate with the UC Merced IT Department to identify and implement WLAN, VLAN, static IP address tables, subnet and routing tables where applicable.
 - b. Coordinate with the lighting systems installer for programmatic and lighting zone requirements.
 - c. Coordinate with the General Contractor to confirm installation requirements prior to installation. Verify structural mounting requirements are adequate to support equipment installation. Confirm that all pathways, back boxes, and conduits are installed per the construction documents and AV systems requirements.
 - d. Coordinate with the General Contractor to ensure that equipment installed under Section 274113 coordinates with the work of this Section. Confirm the locations and types of projector and display mounts, projector lifts, and projection screens are compatible with this work.
 - e. Coordinate with the audiovisual systems programmer, whose work is specified in another section, for the installation and testing of the control system programming.
 - f. Obtain from the Owner the current control system port assignments. Provide this document to the audiovisual systems programmer.
 - g. Coordinate for the integration of existing components or new components, provided by the Owner into the audiovisual system. Provide required mounting hardware, rack panels, cable, connectors, etc. to ensure proper operation of the OFE systems as specified.
 - h. Coordinate with University IT representative for the program requirements of the control system interfaces.
7. Testing and Adjustment: Perform all tests and adjustments, furnish all test equipment necessary and perform all work required to properly configure the systems and to verify their performance in accordance with the information in this Specification and the Integrator's approved engineered designs.
8. Acceptance Testing: Prior to Owner acceptance and hand-over of the completed Audiovisual Systems, demonstrate the operation of the complete systems, including all individual devices and specified control functions. Both subjective and objective tests may be required by the Owner to determine compliance with the information in this Specification and the Integrator's approved designs.
9. Training: Provide technical training of Owner's staff, instructing them on Audiovisual Systems operation, maintenance and troubleshooting.
10. Warranty: Warranty the Audiovisual Systems in accordance with the terms of this Specification.

C. Conditions and Requirements

1. Refer to Bidding Requirements, Contract Forms, Conditions of Contract, and Division 1, General Requirements. Provisions listed or specified therein apply to work under this section.

- D. Related Divisions and Sections: Coordinate the work of this section including, but not limited to, the following other divisions, sections, and trades:

1. Division 01: General requirements
 2. Section 27 41 13: Installed projection screens and projector lifts
 3. Section 06 20 00: Finish carpentry
 4. Division 23: Heating, ventilating, and air conditioning systems
 5. Division 26: Electrical systems
 6. Division 27: Communications systems
- E. Alternates: Submit a written request for modification to an installation practice desired or required which is contrary to these specifications or drawings. Obtain written approval from the Consultant prior to performing modifications.
- F. Unit Prices: Submit unit prices, as derived from the quotations in the Schedule of Values, for adjustments to the contract price. Unit prices shall include material, labor, shipping, tax, markups (overhead, profit, job expenses, bond), labeling, records, and as-built drawing production costs.

1.03 REFERENCES

- A. Comply with the References requirements of Section 27 00 00.
- B. In addition to the references (codes, standards, etc.) listed in Section 27 00 00, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
- C. Perform work in accordance with applicable requirements of governing codes, rules and regulations including the following minimum standards, whether statutory or not:
1. FCC Federal Communications Commission
 2. City, and other local codes and requirements
 3. UL Underwriters Laboratories
 4. ASTM American Society for Testing Materials
 5. NEMA National Electrical Manufacturers Association
 6. ANSI American National Standards Institute
 7. ETL Electrical Testing Laboratories
 8. SMPTE Society of Motion Picture and Television Engineers
 9. EIA Electronic Industries Association
 10. ISO International Standards Organization
 11. Sound Systems Engineering, 2nd Ed., Davis and Davis, Howard W. Sams Co., 1987
- D. Install products and systems that comply with the following standards:
1. ANSI/InfoComm 1M-2011: Audio Coverage Uniformity in Enclosed Listener Areas
 2. ANSI/InfoComm 3M-2011: Projected Image System Contrast Ratio
 3. NFPA 262: Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
 4. UL 813: Commercial Audio Equipment
 5. UL 1419: Professional use Video and Audio Equipment
 6. UL 1480: Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
 7. UL 1492: Audio-Video Products and Accessories

8. UL 60065-1: Audio, Video and Similar Electronic Apparatus

1.04 DEFINITIONS

- A. Definitions in Section 27 00 00 apply to this section.
- B. In addition to those Definitions of Section 27 00 00, the following terms used in this specification are defined as follows:
1. Owner or Client: shall refer to University of California, Merced
 2. Architect: shall refer to SCB Architects.
 3. Project Manager (CM): shall refer to Sundt
 4. AV Consultant: (AV Consultant, Consultant) shall refer to TEECOM
 5. Audiovisual Integrator: shall refer to: The selected bidder.
 6. "A/R" indicates a quantity is: As Required
 7. The term "OFE" refers to University-Furnished Equipment. Provide for removal, relocation and testing prior to installation. Coordinate the integration of existing components or new components, provided by the University into the audiovisual system. Provide required mounting hardware, rack panels, cable, connectors, etc. to ensure proper operation of the OFE systems as specified
 8. "Custom" indicates systems or components that shall be fabricated by the Contractor based on these specifications and drawings
 9. "Future" indicates equipment that will be added to the systems by the Owner or Owner representative at a later date. Provisions shall be made for this equipment
 10. "Or equal" indicates equal in materials, size, color, design, function, efficiency of specified, and conforming with base bid manufacturer/model
 11. The term "CFCI" indicates Contractor-furnished, Contractor-installed equipment
 12. The term "OFCl" indicates University-furnished, Contractor-installed equipment
 13. "Shall" denotes a mandatory requirement, "Should" denotes an advisory statement, "Will" indicates an informative statement
 14. "Broadcast" the transmission stream of content from one location to another. May consist of analogue, broadband, IP, or HDbaseT signal format
 15. Video / Computer Display: Large screen display of video and computer media. Display technologies may include projection and/or flat panel monitors
 16. Interactive Display: Video / Computer display that provides for direct interaction with content or computer sources through technology integrated with the display
 17. Program Audio Reproduction: Playback of sound from recorded audio, video and computer media
 18. Voice Reinforcement: Amplification of presenter voice in large facilities to enhance speech intelligibility
 19. Videoconferencing: Audio and video acquisition electronics (i.e. microphones, cameras) and signal distribution equipment to enable individuals at appropriately equipped remote locations to participate and/or observe activities within designated local facilities
 20. Integrated Control: Universal control of all sub-system audiovisual functions from a single remote control interface
 21. Interface: Single location where PC, video, data or other signal types are connected to the room control and media distribution and presentation systems

1.05 RELATED WORK BY OTHERS

- A. Coordinate with other trades and interface with other base building systems to ensure proper integration and operation of AV systems. Request from the Owner, General Contractor or Architect complete project design drawings and specifications to coordinate their work with the work of others.
- B. Millwork and Cabinetry
1. Coordinate all millwork and cabinetry modifications required to accommodate the installation of Audiovisual Systems, equipment and related cabling and connections, except as may be individually identified in the Specification, shall be provided by others.
- C. Owner Furnished Equipment
1. All equipment in this Section will be purchased by the Owner and provided to the contractor responsible for the work of this Section.
- D. Electrical System Connections
1. Technical Power Service: Coordinate all electrical panels, power receptacles, lighting fixtures, dimmers, lighting controls, and interconnecting wiring shall be supplied by others.
 2. Extend AC power circuits and insulated ground wires into each equipment rack. This work must be done by a qualified electrician, licensed in the jurisdiction of this project, and under contract to the Audiovisual Integrator.
- E. Information Technology Systems
1. Coordinate required data networking, client / server computing and peripherals, digital video storage and distribution systems with the appropriate Owner organizations.
- F. Raceways (conduit and back boxes)
1. Provide blank plates or panels for all AV floor, wall, and ceiling boxes that are indicated on the AV conduit drawings, but do not have AV devices and/or connectors at the time of system commissioning. Coordinate colors and types with the Architect. Devices and plates for other trades (HV power, voice/data, and security) within the AV floor boxes are by others.
- G. Cabling
1. Install and terminate all audio, video, and control cabling as noted on the Construction Documents.
 2. Provide all patch cords and cable assemblies required to connect the AV equipment to voice/data outlets. AV equipment includes but is not limited to projectors, control systems, audio DSP and Audiovisual Integrator-supplied patch panel / faceplate mounted pass-through connections. Additional voice/data cabling, unless specifically noted otherwise, is the responsibility of others.
 3. All Category X cabling shall meet Client standards for telecommunications cabling as defined in Division 27 specifications. This includes patch cords, connectors, testing, and certification requirements.
 4. Provide cabling to interface with other systems such as lighting control, shade controllers

and fire alarm devices.

H. Cable Termination

1. Where cable installation is required, this will include wall and/or floor jacks, plates and terminations at all room devices, and service loops at patch bay locations shall be provided by the Audiovisual Integrator.
2. Category-x telecommunication structured cabling systems are not included in this scope of service.

I. Projector and Display Mounting

1. Install all projector and display mounts as indicated on the drawings. Field verify location and structural suitability before attaching projectors, displays and mounts. Any variations from the drawings and specifications or any question of structural integrity shall be brought to the attention of the Architect and AV Consultant before installing the equipment.

J. Low-Voltage Connections to Base-building Devices

1. Low voltage control interfaces for lighting dimmers, window treatments and electric projection screens will be installed by others as a part of the base building. The Audiovisual Integrator shall verify proper operation of these control systems before any interconnection to the AV control system. The Audiovisual Integrator shall provide and terminate control system cabling to low voltage control system interfaces as specified.
2. The Audiovisual control system will provide automatic control of window shades where installed through two dry contact connections to the lighting control system. Where a lighting control system is not present, operation of the shades will be manual and by others.
3. Investigate all hardware and software control conflicts between the base building control systems and the AV control system before interconnecting the systems. Report any conflicts, potential or existing, to the Architect, in writing, before interconnecting the systems. Damage caused to the base building control systems due to the improper connection of AV control systems shall be the sole responsibility of the Audiovisual Integrator.
4. Where indicated, select and install the appropriate cable type from the AV control system to the base building control systems interface locations.
5. Verify proper operation of both the base building control systems and the AV control system after interconnecting the systems, and verify proper operation of both.

K. Building Controls and Security

1. Building controls and security systems, including environmental controls, fire-detection, fire alarm, fire suppression and security systems shall be provided by others.

F. General Design Guidelines

1. Utilize digital connections between systems components wherever possible by the product manufacturer
2. Minimize signal conversions through from source to destination in systems deployment
3. Provide echo cancellation processing wherever microphones and speakers are installed.

1.06 SUPPLIER/INSTALLERS

A. General Qualifications:

1. Firm has been in business providing similar service required by this section for not less than five years.
2. Firm can outline the general scope of past projects, normal staffing levels, and union status of shop and field installation personnel.
3. Firm can list a minimum of three projects of similar scope successfully completed in the past 24 months, indicating the location, type of system installed, total contract amount, date completed, and include persons and telephone number to contact.
4. Firm can submit confirmation of current state or local contracting licenses, as required to perform the work under this section.
5. Firm shall be an authorized supplier and installer for all equipment.

B. Firm retains can confirm and submit manufacturer installation and programming certifications for the listed manufacturers.

1. AMX programming certification required.
2. Clearone certification

C. Sub-Contract:

1. The Audiovisual Contractor shall have sole responsibility for the satisfactory implementation of each system, regardless of any subcontract arrangement.

1.07 BID SUBMITTAL

A. Provide in accordance with project Bidding Requirements, in addition to the items in this section.

B. Schedule of Values: Provide a Schedule of Values for equipment to be supplied. Each piece of equipment shall be individually priced. Equipment costs shall reflect required modifications and accessories.

C. Non-Equipment Costs: Furnish separately a list of non-equipment costs for each area, by the following categories:

1. Engineering: Including required design, drawings, run sheets, instruction manuals, etc.
2. Pre-Installation: Including fabrication, modification, assembly, rack wiring, etc., performed on the Contractor's premises.
3. Installation: Including on-site installation and wiring, coordination and supervision, testing, checkout, Owner training, etc., performed on the Owner's premises.
4. General and Administrative: Including G & A expenses, shipping, insurance, and guarantees.
5. Taxes: Including applicable Local, State, and Federal taxes.
6. Fees: Including e-Waste disposal fees.

D. Service Contract: Submit service and maintenance costs as outlined in section 3.12.

E. Alternates/substitutions: Refer to Section 270000 for alternate and substitution requirements. Submit bids based on the specified equipment. Submit proposals for alternates and substitutes with associated equipment costs, separate from the costs of the equipment as specified.

1. Proposals for alternate equipment will receive consideration if the differences between the specified and alternate/substituted equipment do not depart from the overall intent of the design and operation of the system and are in the best interests of the Owner.
2. Include in proposals for alternate equipment, full technical information and cut sheets for the proposed equipment.
3. If the inclusion of substituted equipment will result in a different connection configuration than that in the bid documents, produce drawings that illustrate how the proposed system would be connected.

- F. System Enhancements: Submit recommendations which will enhance the performance of the system, or reduce costs without loss of performance, in the bid submission. Suggestions that are of value to the Owner will be taken into consideration in the evaluation of the bid returns. Such proposals shall be made as "alternates", with the appropriate cost modifications shown separate and apart from the costs of the system "as specified".
- G. Required Components:
1. Systems must be complete and fully functional. Whether these components are explicitly enumerated in this Section, audio conferencing systems must include acoustical echo cancellers per microphone unless otherwise indicated and line echo cancellers, for example. Equipment racks must include all cable management, electrical power distribution, blank and vent panels, etc.
- H. Sub-Contract Information:
1. Identify sub-contractors and their responsibilities and qualifications in the bid submission.
 2. Because of the complexity of the systems, the supervision of such sub-contracted work cannot be intermittent. Provide virtually continuous supervision of subcontractors during the installation.
- I. Make exceptions to these specifications and related drawings with the bid submission. In the absence of exceptions, these specifications and related drawings shall be binding in letter and intent. It will further be assumed that the design and specifications have been examined in detail, and full responsibility for the performance of the complete installation as designed and specified is accepted.
- J. Key Personnel:
1. Provide information on the Project Manager, Field Installation Supervisor and other relevant personnel who will be assigned to the project
 2. Indicate factory and industry certifications for involved personnel
 3. Include with your bid a list of all staff that will be dedicated to the integration project along with their resumes and/or listing of technical qualifications.
 4. Notice of CTS Requirement: Note that the submitting firm requires a CTS-I (Certified Technology Specialist – Installation) certified employee to actively manage audiovisual projects. The bidder verifies the validity of CTS credentials at the InfoComm website.
 5. Provide a list of any company-held certifications or designations.
- K. Schedule of Implementation:
1. Site Visit: Make a site visit before submission of bid. Include date of site visit with bid return. Coordinate site visit arrangements with the General Contractor.
 2. Submit a scheduling plan with the bid return indicating the various pertinent terminal dates after award of contract for completion of design, pre-installation work, on-site installation work, and testing and acceptance.
 3. Obtain projected dates when the relevant areas will be available for the on-site installation.

4. Investigate potential contract, union, and scheduling questions, and guarantee compliance with requirements and regulations in effect on the job site.
5. It is possible that certain portions of the work described herein will be ready for use prior to the completion of the entire scope of this specification. The Owner reserves the right to use substantially completed systems without obligation to the Contractor and without implying final acceptance of the systems or equipment so used.

1.08 SUBMITTALS

- A. Product Data: Submit product information for components specified herein prior to the purchase and installation of equipment.
1. Product data sheets for products furnished. Include, for each product, the manufacturer, part number, accessories and options selected or marked directly on the data sheet, color (if applicable), and a brief product description.
 2. Substitutions: Refer to Section 270000 for substitution requirements. Submit requests for substitution based on the specified equipment. Submit these requests with associated equipment costs, separate from the costs of the equipment as specified.
 - a. Proposals for alternate equipment will receive consideration if the differences between the specified and alternate/substituted equipment do not depart from the overall intent of the design and operation of the system and are in the best interests of the Owner.
 - b. Include in requests for substitution, full technical information and cut sheets for the proposed equipment.
 - c. If the inclusion of substituted equipment will result in a different connection configuration than that in the bid documents, produce drawings that illustrate how the proposed system would be connected.
- B. Shop Drawing Submittals
1. General: Submit the following in accordance with the Conditions of Contract and Division 1 Specification Section.
 2. Prior to Fabrication:
 - a. Manufacturers' cut sheets, each with highlighting indicating the item(s) being submitted.
 - b. Panels, plates, and designation strips, including details and samples relating to terminology, engraving, finish and color
 - c. Custom designed consoles, tables, carts, support bases, and shelves
 - d. Schematic drawings of custom circuitry
 - e. Equipment modifications
 - f. Touch screen menus
 - g. Pushbutton control panel layouts including the labels for all buttons
 - h. Handheld remote control panel layouts including the labels for all buttons.
 - i. Audio processor configuration files. It is understood that these files will be modified during system commissioning, but basic routing and processing should be complete and submitted prior to system fabrication.

3. Prior to Assembly and Installation:
 - a. Provide system functional line drawings for all systems. Include equipment names and model numbers (e.g., "Program Amplifier - Crown CT-400"). Clearly label each item of equipment shown on the drawing with the manufacturer's terminal number or input/output designation (e.g., "Mic 1 In", or "Record Out Left").
 - b. Provide equipment rack elevation and patch panel assignment drawings. Labeling on the functional diagrams, rack elevations, patch panels, and on the equipment controls shall be consistent and uniform.
 - c. Provide full-scale drawings of custom plates and panels indicating exact lettering, critical dimensions, and finishes.
 - d. Provide cable run lists. Clearly show at each terminal point the type of connector to be used. Include typical wiring details of each connector. Note where shields are connected and where they will float to ensure the integrity of the grounding system. Indicate cable types and, where appropriate, color codes. Assign wire numbers and patch bay locations to every wire and patch point in the drawing.
 - e. Equipment modification drawings: Include details of modifications that change or void manufacturers' warranties.
 - f. Provide schematic drawings of custom circuitry. Include receptacle pin numbers and component callouts. Show details of custom resistive attenuation and/or combining networks, filters, or pads which may be required in the assembly. Show point-to-point wiring drawings for control system modules and interfaces, and for switches and relays in audio, video, or control systems.
 - g. Provide a list of test equipment, including manufacturer, description and model number, of equipment that will be employed in the testing and adjustment of the installed systems.
 - h. List equipment to be connected to campus computer network. Provide an Excel spreadsheet listing each piece of equipment.
 - 1) Indicate which equipment, if any requires static addressing.
 - 2) Indicate which equipment requires specific network and/or subnet configuration.
 - 3) Indicate equipment which is likely to generate a high volume of network traffic.
 - 4) Indicate equipment with particular QOS requirements.
 - i. Provide a full-scale mockup of the recognition plates as described in the "Installation" section.

C. Prior to Installation:

1. The contractor will make available a review of equipment at the shop location where equipment is being tested, burned-in and pre-assembled prior to installation.
2. Contractor will respond to punch items generated from the pre installation review prior to the installation of equipment within the building.
3. The consultant will provide a list of systems types to that will require a fully functioning mock up prior to installation.

1.10 PERFORMANCE STANDARDS

- A. Meet the following performance standards with each system, unless restricted by the published specifications of a particular piece of equipment. Notify Design Consultant of restriction.
- B. Audio System:
1. Program Audio System:
 - a. Frequency Response: +/- 3 dB per octave band, 100 Hz to 12,000 Hz. 3dB per octave roll off below 100Hz and above 12 kHz.
 - b. Total Acoustical Harmonic Distortion: Less than 2% at 90 dBC (1kHz reference) at four feet above finished floor in the middle of the room.
 2. Distributed Audio System:
 - a. Frequency Response: +/- 3 dB per octave band, 125 Hz to 10,000 Hz. 3dB per octave roll off below 125 Hz and above 10 kHz.
 - b. Total Acoustical Harmonic Distortion: Less than 2% at 85 dBC (1kHz reference) at four feet above finished floor in the middle of the room.
 3. The gain structure for all audio system components (mixer input to amplifier output) shall be adjusted to achieve the highest signal-to-noise ratio, 75 dB from 50 Hz to 15 kHz minimum.
 4. The audio frequency response of the electronics system with equalizers bypassed shall vary less than ± 1 dB from 50 Hz to 12 kHz.
 5. The electronic system audio distortion shall be less than 0.5% at 1 kHz at the equipment's rated input signal level.
 6. Sound Output Capability: Provide program levels of not less than 95 dB and speech reinforcement levels of not less than 85dB in the seating area without objectionable distortion, rattles, or buzzes, employing as test signals several different samples of recorded music and microphones applied at each system input.
 7. Hum and Noise: Hum and noise shall be inaudible (below the background noise level of the space) under normal operation and as observed in normal seat locations.
- C. Video System:
1. Analog video systems shall conform to ATSC standards, as applicable.
 2. Radio Frequency (RF):
 - a. Visual Carrier Level: +6 dBmV minimum and +16 dBmV maximum at system outlets for utilized channels
 - b. Adjacent Channel Visual Carrier: 3 dB maximum differential at systems outlets
 - c. Non-Adjacent Channel Visual Carrier: 10 dB maximum differential at systems outlets
 - d. Carrier-to-Noise Ratio: 43 dB minimum
 - e. Amplitude Response: Flat within plus-or-minus 1.0 dB
 - f. Signal-to-Noise Ratio: 50 dB minimum for the maximum level of the signal and the interference resulting from cross modulation from other signals on the system, after demodulation
 - g. Outlet-to-Outlet Isolation: 25 dB minimum

- h. Audio carrier: Suppress 15dB below visual carrier for same channel
- i. Splitter/combiners: Slope of 0.8dB, Return loss of 15dB
- j. At no point in the system shall signal level drop below 0dB.

D. Projection System:

1. Image size and clarity: Mount the video projector as indicated on the drawings and project the image onto the projection screen. Projected images shall be of maximum width and maximum height, centered on screen. Image tests shall utilize standard AMI test slides and similar video media to establish any image sizes on the screen.
2. Geometric Distortion: Shall be corrected using physical and/or optical adjustment only. Electronic or digital correction should be used only when called for by the design intent.
3. The total averaged light output from a projector, in lumens, shall be within plus-or-minus 15% of that specified by the projector manufacturer.
4. The light fall-off from the center of the projected image to four corners, as measured at the projected image plane, shall not exceed 50% for video projector images or 35% for slide projector images.
5. Mount and brace projectors, lenses, and mirrors so that there will be no observable movement in the image induced by motor vibration or other mechanical operations.

E. Control:

1. Verify functional operation for specified control operations.
2. Provide feedback of the active function via illuminated or shaded pushbuttons at pushbutton and touch panel control stations.
3. Wireless systems shall neither be the source of, nor be affected by, radio-frequency interference to/from external signal devices.
4. Ensure that ergonomic parameters are taken into account when designing the human interface to the control system. Be aware that the level of technical inclination will vary between users. The following guidelines should be followed:
5. Graphics:
 - a. Avoid abbreviations
 - b. Size lettering at 1/8" minimum
 - c. Maintain background color to lettering/symbol color contrast
6. Positive logic: Avoid conditions which may cause command synchronization conflicts (i.e., alternate action (toggling) on/off without power reset or feedback. Provide power sensors or other devices where necessary to ensure that positive logic conditions are maintained.
7. Timing: Avoid the possibility for two or more serial macros or actions being sent simultaneously to the same piece of equipment through flag checking/setting routines.
8. Linking: Provide linking of functions to require the fewest number of user actions to effectively control the equipment.
9. Defaults: Establish default conditions for the system at power-up including device audio levels, warm-up routine, power conditions, switcher status and other default conditions as required by the University or University's Representative.
10. Volume Memory: Provide easy-to-use memory for volume settings associated with each particular source device. They shall be maintained between alternate selections during each segment of the power-up condition.

11. Status Indication: Buttons (hard and soft) which incorporate pilot light or inverted illumination capabilities shall be addressed through the software and programming.
12. Failsafe: No operation or sequence of operations shall cause the control system to become inoperable or interfere with further procession, correct operations or execution of commands.

F. EDID Management

1. All sources to be set to 1080p60hz wherever available. Video sources not providing this resolution shall be transcoded or scaled to meet this specification.
2. Color space to be set to component at the input or upon transcoding and throughout the system thereafter.
3. Audio to be embedded onto HDMI/DisplayPort as 2 channel stereo wherever available. Where embedded audio is not available the system shall seek 2 channel balanced audio on the auxiliary input.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Bear costs of shipping to the site, and of unusual storage requirements. Make appropriate arrangements, and coordinate with authorized personnel at the site, for the proper acceptance, handling, protection, and storage of equipment so delivered.

1.12 WARRANTY

- A. Warrant all systems except projectors and displays for a minimum of one year from the date of system acceptance by the University. Component warranties shall be honored for the term established by the manufacturer, if greater than one year. Include in the warranty quarterly site visits to check and adjust equipment and restore systems to original performance standards.
- B. The University will provide warranties for projectors and displays.
- C. Activate manufacturers' equipment warranties in University's name to commence on the date of acceptance. In the case of Contractor- modified equipment, the manufacturer's warranty is normally voided. In such cases, provide the University with a warranty equivalent to that of the original manufacturer.

1.13 SOFTWARE LICENSE

A. Nondisclosure

1. In consideration of the disclosure to the University of information relating to all technical aspects of the Deliverables and other proprietary products, technology and/or processes of the AV Contractor, including, but not limited to, drawings, models, photographs, sketches and microfiche, the University agrees:
 - a. To maintain such information (including all portions or copies thereof) confidential in the same manner as its own proprietary information is maintained,

- b. Not to disclose the information (or any portion or copy thereof) to any third party,
- c. Not to use such information (or any portion or copy thereof) for any purpose except maintenance and support of its in-house systems.
- d. The obligations of this Agreement shall not apply to any information which is or which becomes generally known to the public due to publication or by means other than a breach of duty by the University or which becomes otherwise available to the University through legal sources.

B. Obligations Governing the Software

1. Title to and exclusive ownership of the software as licensed hereunder shall at all times remain with the AV Contractor or third party suppliers but the AV Contractor hereby grants to the University, or has obtained for the University from third party suppliers, successive irrevocable, royalty-free, non-transferable and non-exclusive licenses to use the software as licensed hereunder from the date of this Agreement in perpetuity.
2. The University shall have no right to sub-license or part with possession of such software as licensed hereunder or any part thereof to third parties.
3. The original and all copies of the software as well as any updates which may be purchased by subsequent agreement shall be and remain the property of the AV Contractor. Title to all applicable rights in patents, copyrights, and trade secrets in the software will remain with the AV Contractor.
4. The foregoing licenses shall extend to all equipment purchased or utilized by the University.
5. Notwithstanding anything to the contrary elsewhere herein, at no time shall the AV Contractor or third party suppliers be precluded or restricted from selling or licensing software as licensed hereunder identical to the software as licensed hereunder or any part thereof to other customers.
6. Software as licensed hereunder which is the property of any third party will be assumed to have been licensed by its proprietor to the AV Contractor and such software as licensed hereunder shall be directly licensed by its proprietor or sub-licensed to the University with the consent of the proprietor at no cost to the University on the same terms and Clauses as are contained in this Agreement in respect to the AV Contractor's own software as licensed hereunder.
7. All software as licensed hereunder will be, if developed exclusively for the University, delivered with the development system software tools such as cross-assembler, linker, simulator and utilities. In addition, there shall be delivered Application specific notes and operating manuals for the software and hardware that provide transparent access to the software and Hardware control topology.
8. At the time of submitting the System to the Acceptance Tests, the AV Contractor will supply where applicable and having used its best efforts in the case of third party suppliers (best efforts will be demonstrated to the University by copies of correspondence between the AV Contractor and the third party stating the AV Contractor's request and giving the third party statement of compliance or otherwise) to the University media which will contain:
 - a. All source code pertaining to the System
 - b. Instructions and full description of equipment required which will enable the University to create executable programs from source code
 - c. All executable programs

- d. Instructions and full description of equipment required which will enable the University to prepare operating systems and other third party software as licensed hereunder for use
9. For any software as licensed hereunder not developed by the AV Contractor all information, data, codes and documentation distributed to the AV Contractor and otherwise available to the Audio-Visual system.
 10. The above so submitted software as licensed hereunder shall be in a form suitable for immediate access by the System.
 11. In the event that the AV Contractor is unable to supply the source code pertaining to the System the AV Contractor warrants, and the University accepts, that at all times the latest version of the source code from the AV Contractor or any third party supplier has been deposited, at even date of this Agreement, and is available for inspection by the University during normal business hours at any time. The AV Contractor further warrants that the Independent Source Code Depository has been instructed and has acknowledged that the deposited source code will be released to the University upon insolvency of the AV Contractor.
 12. If the University discovers an error in the coding or the logic of the software as licensed hereunder and as supplied under the terms of this Agreement to the University, which prevents the System from performing in accordance with the performance requirements of this Agreement, the University shall notify the AV Contractor of the error and upon request by the AV Contractor will deliver to the AV Contractor its analysis thereof accompanied by complete program, module, data listings and sample runs exhibiting and rectifying the error.
 13. The AV Contractor shall from time to time notify the University of the availability of newer versions of the supplied software as licensed hereunder which the AV Contractor or any third party supplier has released for use by its customers generally and shall, within sixty (60) days of receipt of written request by the University, supply such newer version to the University. Any such software as licensed hereunder provided must be documented as to: -
 - a. The fault being corrected (if any)
 - b. The enhancement it represents
 - c. The restrictions imposed or removed
 - d. The details of modifications to and differences from the version to be replaced
 14. The University shall assist the AV Contractor in its performance under the terms of this Agreement by allowing the AV Contractor to use the University's System, data listings and sample runs to reproduce and/or correct the reported error and to install and check updated versions of the delivered software licensed hereunder.
 15. The AV Contractor represents and warrants that it is the University or licensee of the supplied software as licensed hereunder and has the right to permit the University to use the same. The AV Contractor shall not be liable for any incidental or consequential damages, whether foreseeable or not, even if the AV Contractor has been advised of the possibility of such damages, resulting from or in any way connected with the use of the supplied software as licensed hereunder.
 16. The AV Contractor shall defend any suit or proceeding brought against the University and shall pay any adverse judgment entered therein so far as such suit or proceeding is based upon a claim that the use of the software as licensed hereunder furnished by the AV Contractor under this Agreement constitutes infringement of any copyright or patent,

provided the AV Contractor is promptly notified in writing and given authority, information and assistance (at the AV Contractor's expense) for the defense of same; and the AV Contractor shall, at its own expense and at its option, procure for the University the right to continue to use the said software as licensed hereunder, or to replace the same with a non-infringing release. The foregoing shall not be construed to include any agreement by the AV Contractor to accept any liability whatsoever in respect to copyrights or patents for inventions including more than the software as licensed and furnished hereunder, or in respect of copyrights or patents for methods and processes to be carried out with the aid of said software as licensed hereunder, except those which are inherent in said System as furnished. The foregoing states the entire liability of the AV Contractor with regard to copyright and patent infringement as related to the delivered software as licensed hereunder.

17. The University acknowledges the rights of the AV Contractor and third party suppliers in and to the software as licensed hereunder, including, but not limited to, computer programs, user manuals, other supporting material and data, identifying symbols, passwords, user numbers and security symbols, and further acknowledges that such are properly considered to be trade secrets in that they involve processes and compilation of the information which are secret, confidential and not generally known to the public, and which are the product of the AV Contractor's own expenditure of time, effort, money and creative skills. The University also acknowledges and agrees that the use of the software as licensed hereunder is on a confidential basis for the sole and exclusive use by the University and not for resale, and agrees that it will not use, publish disclose or otherwise divulge to any person, except necessary employees of the University, at any time, either during or after the termination of this Agreement, nor permit its employees to so divulge any such information regarding the software as licensed hereunder, without the prior written consent of an officer of the AV Contractor, except that the University is authorized hereby to reproduce information derived from the software as licensed hereunder for its own internal use by authorized employees. Notwithstanding the foregoing, the proprietary and secret information covered hereby may be disclosed by the University to a third party, person, firm or corporation if such disclosure is unavoidable because of its or their access to or control of the University's computers, provided that this sentence shall not be deemed to permit any use of the software as licensed hereunder which would otherwise be prohibited. Nothing herein shall be deemed to limit any rights of the AV Contractor under copyright, patent or other law.
18. The University shall use the software as licensed hereunder solely and exclusively for its own purposes and shall not, without the prior written approval of the AV Contractor, allow any third party to use the software as licensed hereunder for purposes of any such third party whether or not the University is compensated therefore.
19. The AV Contractor warrants that a copy of the current and previous version of software as licensed hereunder submitted to the University is available from the AV Contractor.
20. Provided that the University has obtained, under the terms of this Agreement or subsequent agreements, all items, such as but not limited to source code and compilers, required to modify the software, the AV Contractor hereby grants the University the right to modify and to enhance the software as supplied and licensed under the terms of this Agreement at its own risks and expense and further agrees such modifications and enhancements developed by the University to be the property of the University without prejudice to the rights of the AV Contractor to the basic software. The University furthermore is under no obligation to notify the AV Contractor of any such modifications and enhancements.

21. The University warrants that all software used for the duration of the warranty period is the software as licensed hereunder and released from time to time by the AV Contractor to the University. Failure by the University to use the software as licensed hereunder and released by the AV Contractor will constitute the conclusion of the warranty period as defined under the terms of this Agreement.
22. Any new version of software as licensed hereunder and delivered to the University by the AV Contractor during the warranty period, under the terms of this Agreement which is deemed, and advised so by the AV Contractor, to rectify a failure which occurred during the operations of an event, will cause the warranty period for the software as licensed hereunder to restart.
23. The AV Contractor hereby warrants the right by the University to any corrective software updates for the next ten (10) years.
24. The AV Contractor restricts any enhancements to software as licensed hereunder to the latest release of software as licensed hereunder only.
25. The AV Contractor warrants that all contracts, contacts and arrangements between the AV Contractor and all third party software suppliers providing software as licensed hereunder will transfer to the University with the successful completion of the Final Acceptance.
26. The University warrants to inform the AV Contractor of all its dealings with third party software suppliers supplying software as licensed hereunder for the duration of the warranty period.
27. The AV Contractor warrants that at no charge to the University it will reply to verbal queries from the University provided that:
 - a. The queries relate to the System provided by the AV Contractor pursuant to this Purchase Agreement
 - b. The query is raised by University staff or an authorized agent of the University
 - c. The query is during the AV Contractor's normal business hours
 - d. The University's Representative or employee has attended standard basic training in the use of the System as provided by the AV Contractor
 - e. The University warrants that the use of this service is not intended as a vehicle for design consultation.
28. The University may make copies of the software in any machine-readable form for back-up purpose only. Any such copies made by the University will include the AV Contractor's copyright notice, together with any other proprietary notices. The University will take all reasonable steps to ensure that the whole or any part of the software is not reproduced or copied (save as aforesaid) by any employee, licensee, invitee or agent of the University or any other person under the control of the University and shall observe all reasonable security in relation to the storage, filing and use of the software and basic materials. The University shall not sell, lease, rent, assign, transfer, deliver or otherwise part with possession of the licensed software or permit any other person, firm or company to inspect or use the software in any way provided that the external auditors formally appointed by the University shall have the power to inspect and have access to the software held on University premises at any time.
29. The University acknowledges that in acquiring the right to use the software it has relied upon its own skill and judgment in the selection thereof and in the use and result it intends to obtain therefore.

C. Software License Terms

1. The AV Contractor warrants that it has the right to grant this software license(s) for the use of the software and that the licenses for software supplied pursuant to this Purchase Agreement authorize the University to use the licensed software in machine readable form on the processing devices which form part of the University's computer processing facilities so designated by make and model in respect of which this license is granted. If the designated processor is inoperative for any reason, any license granted under this Agreement shall be extended to authorize the use of the licensed software on a back-up processing unit until the designated processor is available again. If a designated processor is to be permanently phased-out of operation and replaced by another processor, this license may be transferred to a replacement processor at no costs or liability to the AV Contractor upon written notification to the AV Contractor of the new processor make and model. For the purpose of this Agreement, use is defined as copying for processing any portion of the instructions or data in any licensed software from storage units or media into the designated processor, to the extent authorized above, into another processing unit in the event of malfunction.
2. Any additional licenses for software and/or modifications, alterations and amendments to the licensed software granted to the University by the AV Contractor shall be subject to the terms of any supplemental agreement between the parties, and the conditions of this Agreement insofar as they do not conflict with the terms of the supplemental agreement.

PART 2 - PRODUCTS

2.01 SUPPLIER/INSTALLERS

A. General Qualifications:

1. Firm has been in business providing similar service required by this section for not less than five years.
2. Firm can outline the general scope of past projects, normal staffing levels, and union status of shop and field installation personnel.
3. Firm can list a minimum of three projects of similar scope successfully completed in the past 24 months, indicating the location, type of system installed, total contract amount, date completed, and include persons and telephone number to contact.
4. Firm can submit confirmation of current state or local contracting licenses, as required to perform the work under this section.
5. Firm shall be an authorized supplier and installer for all equipment.
6. Firm shall be an authorized service agent for repairs covered under warranty, for all equipment.

B. Subcontract:

1. No subcontract will be permitted, unless specifically identified in the bid submission.
2. The Audiovisual Contractor shall have sole responsibility for the satisfactory implementation of each system, regardless of any subcontract arrangement.
3. Audiovisual contractor shall provide professional integration services for all CFCI and OFCI equipment indicated in Section 2.2 – Equipment.
4. Audiovisual contractor shall receive, off-load, store and install OFCI equipment.

2.02 EQUIPMENT

- A. Provide equipment as specified in the Equipment Schedule.
- B. Supply the latest model, available at the time of bidding, of each piece of equipment.
- C. Materials: Supply materials and equipment that shall be new and shall meet or exceed the latest published specifications of the manufacturer.
- D. Equipment Schedule

See Appendix at the end of this document

2.03 CUSTOM FABRICATION

- A. Electrical Power Connections: Electrical power junction boxes and circuits will be provided by others. Provide required interconnections to the power system from these junction boxes to the equipment and equipment racks.
- B. Remote Control Panels and Receptacle Plates: Fabricate with 1/8 inch thick #6061-T6 aluminum material. Grain and anodize. Obtain architect's approval of finish before fabricating.
- C. Equipment Rack: Provide power receptacle strips, with "U" ground outlets. Power receptacle strips shall be mounted on the rear interior of the rack space on the left side as viewed from the rear. Insulate power receptacle strips from the rack. Power receptacle strips shall be Middle Atlantic or approved equal. Provide UL-approved fluorescent or LED work light magnetically attached on the upper left interior panel of each rack space.
- D. Audio Transformers: Provide appropriate impedance ratio and power handling capacity for the function intended of audio transformers specified in the system.
- E. Networks and Pads: Provide networks and pads as shown on the drawings or as required to achieve proper impedance matching and levels. Networks and pads shall be balanced. 0.5 watt, 5% composition resistors shall be soldered to fixed connection points at each end.
- F. Loudspeaker Enclosures: Loosely fill with glass fiber to 2 lbs/cu. ft. density prior to installing loudspeakers.
- G. Labeling: Provide permanently mounted 1/32" thick by 1/4" high black lamicoide or anodized, brushed aluminum labels with 1/8" engraved lettering for each piece of equipment and every user-adjustable control and input on the audiovisual equipment. Provide 3/8" to 1/2" high P-touch or Dymo type labels on the back of each piece of equipment. Label should be white with black lettering.
- H. Rack Shelves/Mount Adapters: Provide the appropriate factory or custom rack shelves/mount adapters for equipment installed in the audiovisual equipment rack, whether specifically itemized or not. Acceptable manufacturers for custom rack adapters: Middle Atlantic, Winsted, APC/Stantron.

- I. Provide security covers or shaft locks for all level controls, as appropriate, on all equalizers, crossovers, signal delays, and other adjustable signal processors.
- J. System Functional Diagrams: Provide reduced-size as-built functional diagram for the control, audio and video system. Frame with acrylic cover, or laminate drawing, and mount adjacent to equipment rack.
- K. Seismic Safety: Mount and brace permanently-installed equipment to the building structure to minimize potential damage to personnel or equipment from foreseeable seismic events. Physically bolt audiovisual equipment racks to the floor to prevent toppling. Brace hanging equipment such as video projectors, loudspeakers, graphic cameras, et cetera both to minimize sway and to prevent detachment from the overhead structure.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that electrical requirements including junction boxes, floor boxes, ceiling loudspeaker enclosures, empty conduit and power circuits and receptacles are in place as shown on the drawings.

3.02 INSTALLATION

- A. General: Include the delivery, unloading, setting in place, fastening to walls, floors, ceilings, counters, or other structures where required, interconnecting wiring of the system components, equipment alignment and adjustment, and other work, whether or not expressly required, which is necessary to result in complete operational systems.
- B. Physical Installation:
 - 1. Firmly secure equipment in place unless requirements of portability dictate otherwise.
 - 2. Mount permanently and/or provide a mechanical index insuring precise alignment of the projected image of optical projectors.
 - 3. Provide adequate support for fastenings and supports with a safety load factor of at least three.
 - 4. Secure plumb and square boxes, equipment, etc.
 - 5. Give consideration, not only to operational efficiency, but also to overall aesthetic factors in the installation of equipment and cable.
- C. Cable Installation:
 - 1. Mark cables, regardless of length, with permanent, non-handwritten number or letter cable markers within six inches of both ends. There shall be no unmarked cables in the system. Marking codes used on cables shall correspond to codes shown on drawings and/or run sheets.
 - 2. Furnish screw-type terminal blocks, boards, strips, or connectors, for cables which interface with racks, cabinets, consoles, or equipment modules. Terminate wires

- terminating at screw-type terminals with crimp-on lugs. "Telephone-style" punch-down blocks are not acceptable for signal or data wiring.
3. Group cables according to the signals being carried. In order to reduce signal contamination, form separate groups for the following cables:
 - a. Power cables
 - b. Control cables
 - c. Video cables
 - d. Microphone audio cables
 - e. Line audio cables
 - f. Loudspeaker audio cables
 - g. Broadband RF cables
 4. As a general practice, run power cables, control cables, and high level cables on the left side of an equipment rack as viewed from the rear. Run other cables on the right side of an equipment rack, as viewed from the rear.
 5. Unless otherwise called for in these specifications and drawings, use the following cables:
 - a. Video cable RG59: Extron RG59, Liberty RG59-CCTV-CM-BLK
 - b. Plenum-rated video cable: Extron RG59P, Liberty RG59-CCTV-PL-BLK
 - c. Microphone and line-level audio cable: West Penn 454, Liberty 20-2C-SH-GRY
 - d. Plenum-rated microphone and line-level audio cable: West Penn 25291B, Liberty 20-2C-PSH-GRY
 - e. Program loudspeaker cable: West Penn 227, Liberty 12-2C-GRY
 - f. Plenum-rated program loudspeaker cable: West Penn 25227B, Liberty 12-2C-P-BLK
 - g. Distributed loudspeaker speaker cable: West Penn 224, Liberty 18-2C-GRY
 - h. Plenum-rated distributed loudspeaker speaker cable: West Penn 25224B, Liberty 18-2C-P-BLK
 - i. MATV trunk cable: West Penn 25821, Liberty RG11-CCTV-PL-WHT
 - j. MATV drop cable: West Penn 25841, Liberty 18-CMP-VID-COAX-BLK
 - k. Control cable: West Penn 77350, C4215, Liberty LLINX-U
 - l. Plenum-rated control cable: West Penn D25350, Liberty LLINX-U-P
 - m. RGBHV signal cable: Extron M59-5, Liberty RGB5C-23-CM
 - n. RGBHV mini-cable: Extron MHRHF-5, Liberty RGB5C-25-CM
 6. Acceptable cable manufacturers: West Penn, Canare, Belden, Extron, Covid, Gepco, and Liberty.
 7. Provide a service loop of appropriate length within racks and at boxes or points of termination.
 8. Install no cable with a bend radius less than that recommended by the cable manufacturer.
 9. Clearly identify cable terminated in a floor pocket with permanent, indelible labels within 6" of the cable connector. Provide strain relief for cables. Provide a minimum of 3' of free cable coiled in the floor pocket. Use spiral wrap to group similar cable types.
 10. Use plenum-rated cable in plenum-rated spaces. Where plenum-rated cable is used, provide plenum-rated and approved tie-wraps and supports (Thomas & Betts #TYV525M, or approved equal).

D. Jacks and Connectors:

1. Panel-mounted jacks must be recessed and have isolated grounds.
2. Contacts must be silver- or gold-plated, bronze or brass.
3. Unless otherwise called for in these specifications and drawings, use the following types of jacks:
 - a. Microphone: XLR-3 female
 - b. Line level audio: Combination XLR-3/1/4 TRS
 - c. Loudspeaker: Neutrik Speakon
 - d. Video: BNC
 - e. RF: F
 - f. Camera: Triax or multi-pin bulkhead
 - g. Wired Remote Control (multiplex signal): XLR-5 female
 - h. Wired Remote Control (relay contacts): Neutrik Neutricon
4. Acceptable Manufacturers: Canare, Switchcraft, Neutrik, Amphenol, Pomona, Extron, or Liberty.
5. Receptacle Plate Designation: Clearly engrave wall mounted receptacle plates with alphanumeric identification of input type (i.e., mic, line, speaker, video etc) and corresponding patch field designation.

E. Patch Panels:

1. Assignments: Wire patch panels so that signal "sources" (outputs from) appear on the upper row of a row pair; and "loads" (inputs to) appear on the lower row of a row pair.
2. Designation Strips: Utilize alphanumeric identifications and descriptive information on audio and video patch panel designation strips. Number the jack positions in each horizontal row sequentially from left to right. Letter the horizontal jack rows sequentially from top to bottom. Include the alphanumeric identification of each jack on the functional block drawings, as well as on reproductions of these drawings which shall be mounted in an appropriate location near the patch bays.

F. Grounding Procedures: In order to minimize problems resulting from improper grounding, and to achieve maximum signal-to-noise ratios, adhere to the following grounding procedures:

1. General: Because of the great number of possible variations in grounding systems, follow good engineering practice, as outlined above, and deviate from these practices only when necessary to minimize crosstalk and to maximize signal-to-noise ratios in the audio, video, and control systems.
2. System Grounds: Establish a single primary "system ground" for the systems in each particular area. Connect grounding conductors in that area to this primary system ground. Provide the system ground in the audio equipment rack for the area. The ground shall consist of a copper bar of sufficient size to accommodate secondary ground conductors.
3. Rack Ground:
 - a. Connect the No.6 insulated copper wire connected to the earth ground to the primary system ground busbar in the Equipment Rack.

- b. Bond a No.12 TW stranded wire from the Equipment Rack frame to the primary system ground bus bar.

4. Equipment Grounds: Grounding methods used will be dependent upon individual equipment interconnection of chassis ground, circuit common, and power supply common within the units. Provide ground method for equipment types as follows:

- a. Equipment having a 3-wire power cord with green wire of the power cord connected to chassis (Signal common is not internally connected to chassis): Make no connection from chassis ground to primary systems ground busbar in Equipment Rack.
- b. Equipment having a 3-wire power cord with green wire of the power cord connected to chassis: Make no connection from chassis ground to primary system busbar, but do make connection with 14AWG insulated wire from circuit common to primary system ground busbar in Equipment Rack. Separate circuit common from chassis ground.
- c. Equipment having a 2-wire power cord, no green wire, neutral is not tied to chassis, and circuit common is tied to chassis: Make connection from chassis to primary system ground busbar using 14AWG insulated wire.
- d. Audio Cable Shields: Ground audio cable shields at one point only. There are no exceptions. For inter- and intra-rack wiring connect the shield at one end only. For ungrounded portable equipment, such as microphones, connect the shield at both ends but grounded at only one end.

G. Recognition: Provide a single-rack-unit high plate for each rack with Teecom's logo, the Contractor's logo and the following text:

- 1. Designed by: TEECOM: www.TEECOM.com
- 2. Installed by: [Contractor Name]. [Contractor telephone number].

3.03 PROGRAMMING

A. AV Systems Management Tool

- 1. Coordinate with the University to establish room schedules for AV system power management.

B. Media Wall

- 1. Provide programming that allows a presenter to select an input, display it on the wall, move and resize it.
- 2. Provide store and recall functions to allow configurations of the Media Wall to be saved, named, and reused.

C. Power Control

- 1. The audiovisual control system will turn off all non-essential AV equipment.
- 2. Everything but the control processor will be turned off when a user turns off the system or it is turned off via the Systems Management Tool.

3. Power turn-on and turn-off must be sequenced to ensure that thumping and other audible and visual artifacts are minimized and that power on/off cycles do not damage equipment.
4. Users must be apprised, via an animation displayed on the touch panels (such as a thermometer graph) with accompanying text and a seconds count-down, how much time power-on will take.

D. Lighting Interface

1. Coordinate with the electrical contractor for interface with automated lighting and, where appropriate, window shade control systems.
2. Coordinate AV control system programming design to ensure lighting scene buttons and the triggering of lighting scenes stored in lighting systems are correct and consistent with the University's requirements.

E. AV Systems Programming

1. Obtain programming direction and templates from the University. Provide programming that is consistent with the University's requirements.

F. Lecture Hall Audio System Programming

1. Program audio processors to provide zoned delay to loudspeakers greater than 25 feet from the lectern.
 - a. Program delay time to create Haas effect reinforcement of the lectern microphone.
 - b. Create multiple delay zones for the large lecture halls.
2. Program audio processors to provide monaural, delayed program amplification via loudspeakers more than 25 from the program loudspeakers.
 - a. Program delay time to create Haas effect reinforcement of program audio.

G. Lecture Hall Remote Camera Control (Room 130 only)

1. Provide in the user interface programming, controls to allow the adjustment of the overhead camera's focus and zoom.
2. Provide buttons to switch between the camera's focus modes and any other user modes, such as Normal/Invert, etc.

3.04 IT COORDINATION

- A. Coordinate IP addressing and other network configuration with University.

3.05 FIELD QUALITY CONTROL

- A. Initial Tests and Measurements: Before final adjusting and acceptance tests are scheduled, perform system checkout. Furnish required test equipment and perform work necessary to

determine and/or modify performance of the system to meet the requirements of this specification. Include the following:

1. Test audio, video, RF, optical, and remote control systems for compliance with the functional requirements and Performance Standards.
2. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications.
3. Prepare and maintain documentation of performance tests, including numerical values of established equipment settings, for reference during the System Acceptance Tests. Submit final results prior to scheduling Final Acceptance Tests Manual.
4. Install 1/8" diameter vinyl "map dots" as indicators for nominal operating positions of rotary, slider, or switch controls available for operator adjustment. Provide multiple indicators, adequately distinguished, for controls having more than one nominal operating position.
5. Follow Electronic Industries Association Standards RS 219 and RS 160 in performing these tests.

B. Audio System:

1. Loudspeaker-Line Impedance: Measure the impedance at 250 Hz, 1 kHz, and 4 kHz and the resistance of each loudspeaker line leaving the sound equipment rack with the line disconnected from its normal driving source. For lines to full-range distributed loudspeaker systems, measure the magnitude of impedance at 1 kHz.
2. Hum and Noise Level:
 - a. Measure the hum and noise levels of the overall system for each microphone input channel and line-level input channel.
 - b. Adjust gain controls for optimum signal-to-noise ratio so that full amplifier output will be achieved with 0 dBm at a line-level input.
 - c. Terminate line-level inputs with shielded resistors of 150 and 600 ohms, respectively, for these measurements.
 - d. Disconnect the loudspeaker lines and terminate the power-amplifier outputs with power resistors for these measurements. The value of the load resistor shall be within 5% of the nominal load impedance of the amplifier under test. The power rating of the resistor shall equal the power rating of the amplifier.
3. Frequency Response of the System:
 - a. Measure the frequency response using the audio systems as described in Part 1. Adjust gain controls and equalizers to provide the octave-band sound levels as specified.
 - b. Programmable Equalizers: Provide necessary controller with full audio spectrum display for the adjustment of programmable equalizers during system checkout. Do not provide equalizer programmers with the systems.
4. Uniformity of Coverage: Measure octave band of pink noise test signal, centered at 4 kHz, played through loudspeaker system.
5. Power-Output and Signal-Level Adjustment within System:

- a. Measure the electrical distortion of the overall system for each line-level input channel.
 - b. Adjust gain control as for the tests specified herein.
 - c. Apply a 1-kHz sine-wave signal from an oscillator having less than 0.5% total harmonic distortion at the input tested, at a level required to produce full amplifier output. Note that a pad with 150-ohm output impedance is required for driving the microphone-level input in accordance with the EIA standard.
 - d. Use a distortion analyzer to measure the output level and the total harmonic distortion of the amplification and control equipment. In the absence of a distortion analyzer, a high input impedance measuring device such as a DMM may be used to measure the output level. Lack of clipping or apparent deformation of a sine-wave input signal at the power-amplifier output, as seen on the oscilloscope, may serve as evidence that distortion of amplification and control equipment is within acceptable limits.
 - e. Make measurements with loads actually incurred in the system operation. Power-amplifier loads shall be power resistors equal to the nominal load impedance of the output terminals used in the system.
6. Loudspeaker Polarity
- a. Perform polarity checks of loudspeaker lines by means of a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Loudspeaker lines shall be identically polarized with respect to color coding.
 - b. Test polarity of the loudspeakers using a sine-wave test signal warbled about 500 Hz. The listener shall be located on axis of the loudspeaker. Switch the loudspeakers from nominally in polarity to nominally out of polarity with respect to the selected loudspeaker. With the loudspeakers in proper polarity, the quality and clarity of the music or speech should be greater, and the warble test signal should clearly come to the surrounding space from the loudspeaker.
7. Freedom from Parasitic Oscillation and Radio-Frequency Pickup:
- a. With systems set up for each mode of operation specified in the functional requirements, check to ensure that systems are free from spurious oscillation and radio-frequency pickup, in the absence of audio input signal and when the system is driven to full output at 100 Hz.
 - b. Employ an oscilloscope having at least 5 MHz bandwidth for these checks.
 - c. Apply slow sine-wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power-amplifier output voltage to each system. Listen carefully for buzzes, rattles and objectionable distortion.
 - d. Correct causes of these defects unless the cause is clearly from other than the sound amplification system's equipment and installation, in which case bring the cause to the attention of the Architect.
8. Audio Test Signal Paths: Verify operation from source inputs (for microphones, audio tape units, video tape units, etc.) through ADAs, mixers, switchers, etc., to signal destinations.

C. Video System:

1. Input Signal Level: Measure standard composite signal level to be 1.0 volt peak-to-peak with oscilloscope, across standard input impedance.

D. Optical System:

1. The light intensity shall be measured at five positions of the projected image (center and four corners) after the projector has been adjusted to provide the light output as specified above.
2. The "corner" locations shall be defined as the four points determined by intersecting lines drawn 5% of the distance in from the focused edges of the image.
3. The light meter used for the above measurements shall be a properly calibrated footcandle (or lux) meter and shall be cosine-corrected.

E. Control System:

1. Verify operational functions at each control receptacle position.
2. Verify operational functions of wireless control device.
3. Verify operational functions of the control system and interfaced devices.

F. Radio Frequency (RF) System:

1. Use an ATSC-compatible television receiver connected to each system outlet. Confirm all transmitted channels may be viewed with no visible nor audible artifacts
2. Using an RF signal strength meter, record the signal levels in dBmV of modulated carriers transmitted through the system at representative outlets.
3. RF Test Signal Paths: Verify proper operation of the system from source inputs to the head end, including antennas, CATV feeds, and modulators, through line amplifiers, splitters, and directional couplers, to system outlets.

3.06 UNIVERSITY TRAINING

- A. Provide on-the-job training by a suitably qualified instructor, to designated personnel, to instruct them in the operation and maintenance of the systems.
- B. Arrange with the equipment manufacturer for such instruction, at no additional cost, in the event qualified instructors are not available on staff for certain sophisticated equipment.
- C. Schedule the first training after the systems are operational. Provide a minimum of 4 hours of training (total) on the systems included in this specification.

3.07 SYSTEM ACCEPTANCE TESTS

- A. System acceptance tests shall not be performed until the initial system checkout and the initial testing and tuning report has been completed by the Contractor. The system acceptance tests consist of the following:
 1. Take a physical inventory of equipment on site and compare to equipment lists in the contract documents.

2. Demonstrate the operation of system equipment.
 3. Both subjective and objective tests will be required to determine compliance with the specifications. Provide test equipment specified for these tests.
 4. Provide final, "as-built" drawings, run sheets, manuals, and other required documents, as detailed in Part 1.
- B. In the event further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the Architect.
1. If the need for further adjustments becomes evident during the demonstration and testing, continue work until the installation operates properly. Included in the continued work shall include, but not be limited to, changes to or installation of resistive pads, readjustment of loudspeaker aiming, adjustment of system equalizers, programming changes to the control system, convergence of the video projector, if these adjustments are required.
 2. If acceptance of the system is delayed because of defective equipment or because the equipment does not fulfill this specification, reimburse the University for time and expenses for these tests during extensions of the acceptance-testing period.

3.08 CLEANUP AND REPAIR

- A. Upon completion of the work, remove refuse and rubbish from and about the premises, and shall leave the relevant areas and equipment clean and in an operational state. Repair damage caused to the premises by the installation activities, at no cost to the University.

3.09 PROTECTION OF WORK

- A. During the installation, and up to the date of final acceptance, protect finished and unfinished work against damage and loss. In the event of such damage or loss, replace or repair such work at no cost to the University.

3.10 SERVICE AND MAINTENANCE

- A. Provide cost for additional service levels beyond the one-year warranty period and maintenance calls as listed
1. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and same-day issue response
 2. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and 24-hour issue response
 3. One year, two-year, and three-year service with quarterly pre-emptive maintenance calls and 48-hour issue response
- B. Pre-emptive maintenance minimum requirements:
1. Cleaning of filters, lenses and general dusting of all equipment
 2. Verification and adjustment of focus and projector position
 3. Verification that all controlled devices are functioning

4. Note any conditions that may affect the continued functioning of the audiovisual system and report to University
5. Report projector lamp life to University and replace lamp as directed

END OF SECTION

SECTION 27 4117

AUDIOVISUAL SYSTEM CONTROL SOFTWARE PROGRAMMING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This specification section defines control system programming services to be provided for audiovisual systems. These systems are described in another section.

1.02 SUMMARY

- A. Provide control system programming for the included systems.
1. Obtain from the Owner, modules, files, guidelines and standards, and other code and descriptive documents required to perform this work.
 2. Where programming directives provided by the Owner conflict with those in this document, the Owner's directives take precedence.
 3. Develop programs for the included systems utilizing the provided software components and fully adhering to the provided guidelines and standards.
 4. Install and full debug the programming.
 5. Provide fully-documented source code and all software components developed for, and required by the included systems.
- B. Delivery of the work described in this Specification shall include, but not be limited to, the following Basic Services:
1. Submittal Information: Provide illustrations (screen captures, etc.) of control system user interfaces.
 2. At minimum, coordinate as follows:
 - a. Coordinate with the UC Merced IT Department to obtain their standard software modules.
 - b. Coordinate with UCM IT for interface with the campus AMX RMS system.
 - c. Coordinate with UCM IT for lighting zone designations.
 - d. Coordinate with the lighting system integrator for protocol requirements. Coord with them for AV control system control of any other devices (shades, etc.) interfaced with the lighting control system.
 - e. Coordinate with UCM IT for integration with the campus classroom scheduling system
 3. Test all of the features and capabilities of the software in this Work.
 4. Prior to Owner acceptance and hand-over of the completed audiovisual systems, demonstrate the operation of the completed systems, including all individual devices and specified control functions.

5. Train the Owner's staff, instructing them on the use, maintenance, and troubleshooting of this software.
 6. Warrant the audiovisual systems in accordance with the terms of this Specification.
- C. Related Divisions and Sections: Coordinate the work of this section including, but not limited to, the following other divisions, sections, and trades:
1. Division 00, "Procurement and Contracting Requirements"
 2. Division 01, "General Requirements"
 3. Division 26, "Electrical systems"
 4. Division 27, "Communications Systems"
 5. Section 274113, "Architecturally Integrated Projection Screens"
 6. Section 274116, "Audiovisual Systems"
- D. Substitutions: Submit a written request for modifications to installation practices contrary to these specifications and drawings. Obtain written approval from the Engineer prior to performing modifications.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.04 REFERENCES

- A. Comply with the References requirements of Section 27 00 00.
- B. Refer to Section 274116 for a complete listing of AV equipment.
- C. In addition to the references (codes, standards, etc.) listed in Section 27 00 00, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
- D. Perform work in accordance with applicable requirements of governing codes, rules and regulations including the following minimum standards, whether statutory or not:
 1. FCC Federal Communications Commission
 2. City, and other local codes and requirements
 3. SMPTE Society of Motion Picture and Television Engineers
 4. EIA Electronic Industries Association
 5. ISO International Standards Organization

1.05 DEFINITIONS

- A. Definitions in Section 27 00 00 apply to this section.
- B. In addition to those Definitions of Section 27 00 00, the following terms used in this specification are defined as follows:
 - 1. "Owner" refers to the University of California, Merced
 - 2. "Architect" refers to SCB.

1.06 SUPPLIER/INSTALLERS

- A. General Qualifications:
 - 1. Document that the firm has been in business providing programming services of the brand of control systems used for this Work for not less than five years.
 - 2. Submit confirmation of current state or local contracting licenses, as required to perform the work under this section.
 - 3. Document the certification status of the personal who will be providing the services for this project. Specifically, provide documentation of the current status of the programmer's AMX ACE-P and ACE-RMS certifications.

1.07 SUBMITTALS

- A. Shop Drawing Submittals
 - 1. General: Submit the following in accordance with the Conditions of Contract and Division 1 Specification Section.
 - 2. Prior to Fabrication:
 - a. Touch screen menus
 - b. Pushbutton control panel layouts including the labels for all buttons
 - 3. Prior to Assembly and Installation:
 - a. List equipment to be connected to the campus computer network. Provide a spreadsheet listing each piece of equipment.
 - 1) Indicate which equipment, if any requires static addressing.
 - 2) Indicate which equipment requires specific network and/or subnet configuration.
 - 3) Indicate equipment which is likely to generate a high volume of network traffic.
 - 4) Indicate equipment with particular QOS requirements.

1.08 PERFORMANCE STANDARDS

- A. Control:
 - 1. Verify functional operation for specified control operations.
 - 2. Provide feedback of the active function via illuminated or shaded pushbuttons.

3. Defaults: Establish default conditions for the system at power-up including device audio levels, warm-up routine, power conditions, switcher status and other default conditions as required by the Owner.
4. Volume Memory: Provide easy-to-use memory for volume settings associated with each source device. They shall be maintained between alternate selections during each use session, but shall be overridden by Owner-approved defaults when the system is turned off and back on.

1.09 SOFTWARE LICENSE

A. Ownership

1. The software developed for this Work will be the property of the Owner.

B. Right to Reuse and Distribute

1. The software developed for this Work will be installed only on the control systems described above. No right is granted for installation on additional systems.
2. The Owner may not provide any portion of the software to others without the permission of the Developer.
3. The Owner may provide screen shots and other user interface details for promotion and similar purposes.
4. The Developer may not reuse programming components provided by the Owner without the Owner's express permission.

1.10 SUPPLIERS/INSTALLERS

A. Subcontract:

1. No subcontract will be permitted.
2. The Contractor shall have sole responsibility for the satisfactory implementation of each system.

PART 2 - PRODUCTS

2.01 DOES NOT APPLY

PART 3 - EXECUTION

3.01 PROGRAMMING

A. AV Systems Management Tool

1. Coordinate with the Owner to establish room schedules for AV system power management.

B. Media Wall

1. Provide programming that allows a presenter to select an input, display it on the wall, move and resize it.
2. Provide store and recall functions to allow configurations of the Media Wall to be saved, named, and reused.

C. Power Control

1. The audiovisual control system will turn off all non-essential AV equipment: Everything but the control processor will be turned off when a user turns off the system or it is turned off via the Systems Management Tool.
2. Power turn-on and turn-off must be sequenced to ensure that thumping and other audible and visual artifacts are minimized and that power on/off cycles do not damage equipment.
3. Inform users, via an animation displayed on the touch panels, such as a thermometer bar with accompanying text and a count-down, how much time power-on will take.

D. Lighting Interface

1. Coordinate with the electrical contractor for interface with automated lighting and, where appropriate, window shade control systems.
2. Coordinate AV control system programming design to ensure lighting scene buttons and the triggering of lighting scenes stored in lighting systems are correct and consistent with the Owner's requirements.

E. Owner-Provided Software Components

1. Obtain programming direction and software components from the Owner.
2. Provide programming that is consistent with the Owner's requirements.

F. Lecture Hall Remote Camera Control (Room 130 only)

1. Provide in the user interface programming, controls to allow the adjustment of the overhead camera's focus and zoom.
2. Provide buttons to switch between the camera's focus modes and any other user modes, such as Normal/Invert, etc.

3.02 IT COORDINATION

- A. Coordinate IP addressing and other network configuration with the Owner.

3.03 FIELD QUALITY CONTROL

A. Control System:

1. Verify operational functions at each control receptacle position.
2. Verify operational functions of the control system and interfaced devices.

3.04 SYSTEM ACCEPTANCE TESTS

- A. System acceptance tests shall not be performed until the initial system checkout and the initial testing and tuning report has been completed by the Contractor. The system acceptance tests consist of demonstrating the operation of the software in this Work.
- B. If the need for programming revisions becomes evident during demonstration and testing, continue work until the installation operates properly.

3.05 OWNER TRAINING

- A. Participate in on-the-job training with the audiovisual systems integrator. With them, instruct users in the operation and maintenance of the systems.
- B. Schedule the first training after the systems are operational. Provide a minimum of 4 hours of training (total) on the systems included in this specification.

3.06 SERVICE AND MAINTENANCE

Provide cost for additional service levels beyond the one-year warranty period and maintenance calls as listed.

END OF SECTION

SECTION 28 0500
GENERAL REQUIREMENTS FOR SAFETY AND SECURITY SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. The work of this Section consists of providing all required labor, supervision, materials and equipment (except equipment furnished by the University to be installed by the Contractor) to satisfactorily complete the work shown on the drawings and/or specified in all Sections of Division 28 and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete and fully operating facility. The work shall include but not be limited to the following:
1. 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.

1.2 RELATED WORK:

- A. This Section provides the basic Electrical Requirements which supplement the General Requirements of Division 1 and apply to all Sections of Division 28.

1.3 STANDARDS AND CODES:

- A. All work and material shall be in compliance with and according to the requirements of the latest revision of the following standards and codes:
1. California Building Code (CBC)
 2. California Electrical Code (CEC)
 3. California Fire Code (CFC)
 4. American National Standards Institute (ANSI) Publications:
 - a. C2-02 National Electrical Safety Code
 5. Code of Federal Regulations (CFR):
 - a. 29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)
 6. Electronics Industries Association (EIA)
 7. Institute of Electrical and Electronics Engineers (IEEE)
 8. National Electrical Testing Association (NETA):
 - a. Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, Standard ATS
 9. National Electrical Manufacturers Association (NEMA)
 10. Occupational Safety and Health Act (OSHA) Standards
 11. State of California Public Utilities Commission:
 - a. General Order 128 Rules for Construction of Underground Electric Supply and Communication Systems
- B. Variances: In instances where two or more codes are at variance, the most restrictive requirement shall apply.

- C. Underwriter Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Safety labeling and listing by other organizations, such as ETL Testing Laboratories, may be substituted for UL labeling and listing if acceptable to the University. Provide service entrance labels for all equipment required by the NEC to have such labels.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.5 SUBMITTALS:

- A. As specified in Division 1. Submit to the Engineer shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system specified. Obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review.
- B. Submittals are required for all items, regardless of whether they are furnished as specified or are substituted.
- C. Information to be submitted includes manufacturer's name, trade name, equipment model number, nameplate data, equipment drawings including: size, layout dimensions and capacity, manufacturer's descriptive literature of cataloged products, diagrams, test data, and performance and characteristic curves as applicable. Furnish 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.
- D. If submittal information includes multiple products, items being submitted for approval shall be clearly identified and items not to be used on the project shall be clearly marked out.
- E. Organize submittals for equipment and items related to each specification section together as a package.
- F. Submit submittal packages in three ring binders. Fold drawings and insert into pockets in three ring binders.
 - 1. Certificates of Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this contract. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment,

or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements that imply the item does not meet requirements specified, such as “as good as”, “achieve the same end use and results as materials formulated in accordance with the referenced publications;” or “equal or exceed the service and performance of the specified material.” Certifications shall state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer’s letterhead and shall be signed by the manufacturer’s official, authorized to sign certificates of conformance.

G. Substitutions:

1. The equipment included in the Contract Documents is used to establish standards of quality, utility, and appearance. Equipment which in the opinion of the Engineer is equal in quality, utility, and appearance will be approved as substitutions to that specified.
 - 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 approved by the Engineer prior to bidding.
2. Substitutions will be accepted for review where there is a reasonable reason for the substitution. Reasonable reasons include:
 - a. Cost savings to the University. Include deductive change order with submittal.
 - b. A product with features providing additional benefits to the end user.
 - c. Improved finished environment / Lay out of the final installation.
 - d. Delivery considerations.
 - e. University’s specific requests.
3. Where items are noted as “or equal”, a product of equal design, construction and performance will be considered.
4. Any item proposed as a substitute shall be accompanied by drawings and/or data giving sizes, capacities, all pertinent test data, catalog cut sheets, product information, and all other necessary information required to substantiate that the product is equal or exceeds that specified.
5. Substitutions shall be equal, in the opinion of the Engineer, to the specified equipment. The burden of proof of such shall rest with the Contractor. When the Engineer in writing accepts a substitution, it is with the understanding that the Contractor guaranteed the substituted equipment to be equal to the one specified and dimensioned to fit within the construction. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from any provisions of the Plans or Specifications.
6. Only one substitution will be considered for each product specified.
7. Alternate manufacturers must be submitted for approval 10 days prior to bid date unless noted otherwise in Division 1.
8. The Contractor shall be responsible for all expenses in connection with the substitution materials, process, and equipment, including the effect of his/her substitution on him/her, his/her subcontractor’s or other Contractor’s work. No substitution shall be permitted without written authorization of the Engineer. Any assumptions on the acceptability of a proposed substitution prior to acceptance by the Engineer are at the sole risk of the Contractor.

H. Closeout Submittals:

1. Cost analysis: Submit final cost information including original bid and any change orders broken down by system, material and labor costs (as applicable):
 - a. Fire Alarm System
 - b. Intrusion System
 - c. Surveillance System
 - d. Card Access System
2. Operation and Maintenance Manuals: Furnish O & M Manuals for equipment where manuals are specified in the equipment specifications or are specified in Division 1. Electrical O & M Manuals shall include as a minimum:
 - a. Copies of equipment supplied on the project.
 - b. Instruction manuals including operation instructions and maintenance requirements/recommendations.
 - c. List of suppliers for all equipment with addresses and telephone numbers.
 - d. List of service support for all equipment with addresses and telephone numbers.
 - e. Copies of all test reports required in Division 28 specification sections.
 - f. Spare Parts: For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.
 - g. Other closeout documentation and test results as required under other sections of the specifications.
 - h. Provide in a single transmittal.
 - i. Warranty for all work, including contractor's general warranty.
 - j. All warranties begin as per the Contract, Division 1 or final acceptance of the Work by the University, Architect, Engineer, and Authority Having Jurisdiction, which ever is later:
 - 1) Manufacturer's Warrantees and Guarantees that are longer than the base contract/specified amount are to be provided with the manuals.
 - 2) The Contractor is responsible for all Warranty and Guarantee work whether or not the Manufacturer also Warrantees and Guarantees the product.

1.6 CONTRACT DOCUMENTS:

- A. Review the Drawings and Specification Divisions of other trades and perform the electrical work that will be required for the installations:
 1. Should there be a need to deviate from the Electrical Drawings and Specifications, submit written details and reasons for all changes to the Engineer for favorable review.
 2. All drawings and divisions of these specifications shall be considered as whole. This contractor shall report any apparent discrepancies prior to submitting bids.
- B. Drawings:
 1. The Drawings shall govern the general layout of the completed construction.
 - a. Locations of equipment, inserts, anchors, panels, pullboxes, manholes, conduits, stub-ups, fittings, devices, and ground connections are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.

- b. The general arrangement and location of existing conduits, piping, apparatus, etc., is shown as existing on drawings or specified. The drawings and specifications are for the assistance and guidance of the contractor, exact locations, distances and elevations are governed by actual field conditions. Extreme 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 Engineer.

1.7 COORDINATION:

- A. Coordinate the electrical work with the other trades, code authorities, utilities and the Engineer:
 1. Failure to accomplish this coordination is not a basis for additional cost reimbursement to the Contractor.
 2. Coordinate does not mean to only send a Request For Information. Coordinate implies that the contractor is to take the lead in bringing all of the necessary organizations together to coordinate the work and to provide for the associated costs.
- B. Where connections must be made to existing installations, properly schedule all the required work, including the power and system shutdown periods. Schedule and carry out shutdowns so as to cause the least disruption to operation of the University's facilities:
 1. Include costs for work during non-normal working hours and temporary facilities as may be required.
 2. Include costs as necessary for sub-contractors to accomplish the specified work.
- C. When two trades join together in an area, make certain that no electrical work is omitted. Failure to accomplish this coordination is not a basis for additional cost reimbursement to the Contractor.
- D. Operations:
 1. Perform all work in compliance with Division 1:
 - a. Keep the number and duration of power and system shutdown periods to a minimum.
 - b. Show all proposed shutdowns and their expected duration on the construction schedule.
 - 1) If the construction schedule is created and maintained by others, make sure that the associated information is incorporated.
 - 2) Failure by the Contractor to properly schedule and plan for such activities is not a basis for additional compensation.
 - c. Carry out shutdown only after the Engineer has favorably reviewed the schedule. Submit power/communications interruption schedule 15 days prior to date of interruption. Failure to provide schedule with adequate review time may result in rescheduling of the work at the Contractor's expense.

- E. Construction Power:
 - 1. See Division 1 Temporary Utilities.
- F. Storage:
 - 1. Provide adequate storage for all equipment and materials which will become part of the completed facility so that it is protected from sun, weather, condensation, dust, water, or construction operations.
- G. Damaged Products:
 - 1. Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain approval from the Engineer before making repairs to damaged products.
- H. Order material in such a timely manner and after approval of the same so as to insure that the approved material is available to be installed on site in a timely manner. Additional costs or substitutions necessitated because the Contractor failed to order material in a timely manner are not reimbursable. Costs associated with processing of paperwork by the University and design consultants resultant of such failures to coordinate the work by the Contractor shall have such costs reimbursed by the Contractor

1.8 LOCATIONS:

- A. General:
 - 1. Use equipment, materials and wiring methods suitable for the types of locations in which they are located:
 - a. Dry Locations:
 - 1) All those indoor areas which do not fall within the definition below for Wet Locations and which are not otherwise designated on the Drawings.

1.9 SAFETY AND INDEMNITY:

- A. The Contractor is solely and completely responsible for conditions of the job site including safety of all persons and properly during performance of the work. This requirement will apply continually and not be limited to normal working hours:
 - 1. No act, service, drawing review or construction review by the University, the Engineer or their Consultants is intended to include reviews of the adequacy of the Contractors safety measures in or near the construction site.
 - 2. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify, and defend the University, 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 University, the engineer, their Consultants or their officers, agents and employees.

PART 2 - PRODUCTS

2.1 STANDARD OF QUALITY:

- A. Material and Equipment:
 - 1. 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.
- B. Service Support:
 - 1. 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.
- C. Manufacturer's Recommendations:
 - 1. 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.

2.2 NAMEPLATES:

- 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. Tag all scheduled and uniquely tagged mechanical equipment with engraved nameplates. Nameplates shall be 1/16-inch thick, 3 x 5 laminated 3-ply plastic, center ply white, outer ply black. Form letters by exposing center ply.
- C. The building identification number for this project shall be CAAN #262. Identify each piece of equipment with building number, unit mark as shown on equipment schedules on Drawings, and service. For example: CAAN #0262 - SF-1 SUPPLY FAN
- D. Additionally, identify each piece of equipment and related controls with a rigid laminated engraved plastic nameplate that identifies the specific equipment, e.g. "EF- 1". 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 1 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 screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no inscriptions are indicated on the Drawings, furnish nameplates with appropriate inscriptions furnished by the Engineer upon prior request by the Contractor.

- E. Each control device, including push buttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.

2.3 FASTENERS:

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

2.4 FINISH REQUIREMENTS:

- A. Equipment:
 - 1. Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish which as been damaged or is otherwise unsatisfactory, to the satisfaction of the Engineer.
- B. In finished areas, paint all exposed conduits, boxes and fittings to match the color of the surface to which they are affixed.
- C. Conduits for fire alarm or life safety raceways shall be factory painted red along their entire length.

PART 3 - EXECUTION

3.1 INSTALLATION:

- 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 University.
- C. Equipment Installation:
 - 1. Provide the required inserts, bolts and anchors, and securely attach all equipment and materials to their supports.
 - 2. Mount all metal panels or cabinets which are mounted on or abutting concrete walls or any outside walls $\frac{1}{4}$ inch from the wall, and paint the back sides of the panels with Mobil Hi- Build Bituminous Coating 35-J-10, Kopper Bitumastic Super Tank Solution, or equal. Film thickness shall be 10 mils minimum.

D. Cutting, Drilling and Welding:

1. Provide the required cutting, drilling welding that is required for the electrical construction work. Comply with Division 1 requirements.
2. Structural members shall not be cut or drilled, except after approval by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry.
3. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel. Where welding is required, it shall be accomplished by tradesmen certified to do such work. Provide fire and other protection as appropriate.

3.2 FIELD TESTS:

- A. Test shall be in accordance with Acceptance Testing specifications issued by the National Fire Protection Association (NFPA) 72 Chapter 7 for fire alarm and manufacturer's recommendations for security systems.
- B. Perform equipment field tests and adjustments. Properly calibrate, adjust and operationally check all devices 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 Engineer prior to any test so that the tests may be witnessed.
- C. Provide instruments, supplies, other equipment, temporary facilities as may be necessary and material required for the tests. Instruments shall be of the type designed for the type of tests to be performed and shall be calibrated by a recognized testing laboratory within three months prior to testing.
- 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 Engineer. Repair and re-test equipment and systems which have been satisfactorily tested but later fail, until satisfactory performance is obtained.
- F. Perform calibration and adjustment on all equipment.
- G. Maintain records of each test and submit five copies to the Engineer when testing is complete. All tests shall be witnessed by the Engineer. 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. University or Engineer's initials.

H. Items requiring testing as a minimum:

1. Fire Alarm System.
2. Intrusion System.
3. Surveillance System.
4. Card Access System.

3.3 PAINTING OF EQUIPMENT:

A. Factory Applied:

1. 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. Fire alarm raceways shall be factory painted red.

B. Field Applied:

1. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.4 SIGNAGE:

A. Nameplate Mounting:

1. Provide number, location and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two stainless steel sheet-metal screws or two rivets.

3.5 RECORDS:

A. Maintain one copy of the contract Drawing Sheets on the site of the work for recording the record "as built" condition. After completion of the work, the Contractor shall neatly and 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 the project.
2. Substructure: Where the location of duct lines, adjacent utilities, cable boxes, and manholes are found to differ than shown, carefully mark the correct location on the Drawings. Work shall be dimensioned from existing improvements.
3. Record (As Built) Drawings: At the completion of the Work the Contractor shall provide a set of record "as built" drawings over to the University for his use:
 - a. Record drawings are required to be transmitted within 30 days of beneficial occupancy.
 - b. Transmittal and approval process:
 - 1) Contractor is to transmit one printed copy for review and comment.
 - 2) After acceptance of the above, the Contractor is to transmit three printed sets and one reproducible set.
 - 3) Contractor to provide information on their company in the margin of record drawings along with the date of the revisions and the associated revision number.

3.6 POSTED OPERATING INSTRUCTIONS:

- A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:
 - 1. Single line diagrams, wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - 2. Start up, proper adjustments, operating, lubrication and shutdown procedures.
 - 3. Safety precautions.
 - 4. The procedure in the event of equipment failure, trouble or alarm.
 - 5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

3.7 INSTRUCTION TO UNIVERSITY'S PERSONNEL:

- A. Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or systems has been accepted and turned over to the University for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.
- B. Contractor shall maintain an attendance sheet from each session which contains the following information:
 - 1. Attendees with associated arrival and departure time.
 - 2. Topics covered.
 - 3. Information provided.
 - 4. Signatures of attendees taken at the completion of the session.

3.8 CLEAN UP:

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

END OF SECTION

SCB
PROJECT NO. 2019031

CLASSROOM OFFICE BUILDING(S) 1 RENOVATION
MERCED, CA
PROJECT NO.: 908078

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SECTION 28 0513
WIRE AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 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.

1.2 RELATED WORK:

- A. See the following Specification Section for work related to the work in this Section:
1. 28 0500 General Requirements for Safety and Security Systems

1.3 STANDARDS AND CODES:

- A. Work and materials shall be in compliance with and according to the requirements of the latest revision of the following Standards and Codes:
1. American Society for Testing and Materials (ASTM):
 - a. B3-01, Specification for Soft or Annealed Copper Wire
 - b. B8-99, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft
 - c. B173-01a, Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors
 2. Federal Standards (FED. STD.):
 - a. 228, Methods of Testing Insulated Cable and Wire
 3. Federal Specifications (FS):
 - a. A-A-59544, Cable and Wire, Electrical
 - b. A-A-55809, Pressure Sensitive Electrical Plastic Insulation Tape
 4. National Electrical Manufacturers Association (NEMA):
 - a. WC 70-1999/ICEA S-95-658-1999, Cross-Linked Thermosetting Polyethylene, Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 5. National Fire Protection Association (NFPA), National Electrical Code (NEC) - Latest Revision
 6. California Electrical Code (CEC)
 7. Underwriters Laboratories (UL):
 - a. 44-83 (R1988), Rubber-Insulated Wires and Cable
 - b. 83-1983 (R1989), Thermoplastic-Insulated Wires and Cables
 - c. 510-1986, Insulating Tape

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.5 SUBMITTALS:

A. As specified in Division 1 and Section 28 05 00.

1. Catalog Data: Provide manufacturer's descriptive literature.
2. Single Submittal: A single complete submittal is required for all products covered by this Section.

PART 2 - PRODUCTS

2.1 CONDUCTORS:

A. General:

1. Conductors shall be copper, Class B stranded and of the sizes indicated. All conductors 120 volts and above shall be in raceway unless otherwise noted. Minimum power and control wire size shall be No. 12 AWG unless otherwise specified by the University's Representative. All cable used on this Project shall be of the same type and conductor material.

- ##### B.
- Unless otherwise noted, conductors #6 and larger shall be XHHW insulation suitable for operation in wet or dry locations at temperatures not to exceed 75°C in wet locations and 90°C in dry locations. Conductors #8 and smaller shall be THHN in dry locations and THWN/THHN in wet locations. Control Cable shall be THHN.

C. Insulation Marking:

1. All insulated conductors shall be identified with printing colored to contrast with the insulation color.

D. Special Wiring:

1. Where special wiring is proposed by an equipment manufacturer, submit the special wiring requirements to the University's Representative and, if approved, provide same. Special wire shall be the type required by the equipment manufacturer.

E. Other Wiring:

1. 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 University's Representative.

F. Terminations:

1. Cable Termination for Copper: Crimp style two hole NEMA spade terminals designed and rated for copper cable.

2. Wire Terminations: Crimp on ring-tongue terminals, insulated sleeve, of proper size for the wire used.
 3. End Seals: Heat shrink plastic caps of proper size for the wire on which used.
 4. Manufacturer: T&B, Burndy or approved equal.
- G. Manufacturer: BICC General Cable Inc., Southwire, or approved equal.

2.2 FIRE ALARM CABLES:

- A. Addressable Loop Cables:
1. Verify recommended cable type with system manufacturer. Cable shall be minimum #16 shielded twisted pair, unless otherwise noted. Refer to drawings and 28 31 00 Fire Alarm system for additional requirements:
 - a. Cable for all exterior, underground or wet locations shall be outdoor rated with water-blocked construction, sunlight and moisture resistance jacket. Manufacturer: West Penn AQ293 or approved equal.
 - b. Cable for all interior areas shall be plenum rated cable. Manufacturer: West Penn 60975B or approved equal.
- B. Notification Circuit Cables:
1. Refer to section 2.01 Conductors for Notification Circuit Cables. Refer to drawings for size and quantity. Refer to Specification Section 28 31 00 - Fire Alarm System for additional requirements.

2.3 SECURITY CABLES:

- A. Verify recommended cable type with system manufacturer. Cable shall be minimum #16 shielded twisted pair. Refer to drawings for additional requirements:
1. Cable for all exterior, underground or wet locations shall be outdoor rated with water- blocked construction, sunlight and moisture resistance jacket. Manufacturer: West Penn AQ293 or approved equal.
 2. Cable for all interior areas shall be plenum rated cable. Manufacturer: West Penn 60975B or approved equal.

2.4 TAPE:

- A. Tape used for cable marking shall be compatible with the insulation and jacket of the cable and shall be of plastic material. Tape shall conform to FS HH-I-595 and UL 510.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION:

- A. Clean Raceways:
1. Clean all raceways prior to installation of cables as specified in Specification Section 28 05 00 – Safety/Security System Raceways and Fittings.

B. Cable Pulling:

1. 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.

C. Bending Radius:

1. Cable bending radius shall be per applicable code. Install feeder cables in one continuous length.

D. Equipment Grounding Conductors:

1. Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in any conduit or any raceway.

E. Wiring at Hinges:

1. For cables crossing hinges, utilize extra flexible stranded wire, make up into groups not exceeding 12, and arrange so that they will be protected from chafing when the hinged member is moved.

F. All wiring and cable shall be supported from the structure above. All wiring below 100 volts shall be installed in conduit where concealed and in basket tray where exposed.

G. Low Voltage Cables:

1. All cables provide outside buildings shall be outdoor rated, gel filled cables.
2. All low voltage wires and cables concealed in walls shall be run in EMT conduit from flush outlet boxes to above accessible ceilings. Provide conduit where cables penetrate floors and fire walls above ceilings. Where low voltage cables run parallel to line voltage (over 120 volts), they shall be installed a minimum of 12 inches apart.

3.2 CABLE TERMINATIONS AND SPLICES:

A. Splices:

1. All fire alarm and security cables shall be continuous below grade (i.e. no splices or terminations below grade).
2. Use UL listed wirenuts for line voltage branch circuits in dry locations.

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.

3.3 FIELD TESTS:

- A. The Contractor shall perform the following tests at his expense:
1. Continuity Test of Wire:
 - a. Test each wire for continuity and accuracy of the identifying tags at both ends and at all locations marked. Submit a report to the University's Representative certifying the fact of the test and the accuracy of the marking.
 2. Insulation Resistance Tests:
 - a. Perform insulation resistance tests on all wire and cable installed. Make these tests after all equipment has been connected, except that equipment which may be damaged by the test voltage shall be disconnected. Test the insulation with a 500 Vdc insulation resistance tester with a scale reading not less than 100 megohms. The insulation resistance shall be 2 megohms or more. Submit results for review.

END OF SECTION

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**SECTION 28 1600
INTRUSION ALARM AND ACCESS CONTROL SYSTEM**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. It is the intent of the drawings and specifications that all systems be complete, and ready for operation. Provide all design services required to ensure a fully designed, fully functioning system. No extra charge will be paid for furnishing items required by regulations, but not specified herein, or on drawings.
- B. Furnish and install all materials, equipment, programming, accessories and appurtenances and provide all labor required and necessary to complete the work shown on the drawings and/or specified and all other work and miscellaneous items, not specifically mentioned, but reasonably inferred for a complete security system installation including all equipment required for testing the systems.
- C. Refer to drawings for approximate quantities and locations of devices. Coordinate with the architect for exact location of all devices in public areas.
- D. The University requires the following systems as part of the electronic safety and security of their campus:
 - 1. Access Control and Alarm Monitoring System (ACAMS) to automate opening and closing of the building, restrict access after-hours by cardholder privileges, and monitor specific spaces for intrusion.
 - 2. Video Surveillance System (VSS) to provide real-time monitoring of the facility, a photographic record of access control transactions and alarm events.
 - 3. Security Communications System which includes blue light telephones that may include a Wide-Area Emergency Broadcast System (WEBS)
- E. The Contractor is to furnish and install the devices and equipment required for ACAMS. The ACAMS will connect to the University's existing CBORD Access head-end server located at the UC Merced Telecom Building via the Wide Area Network (WAN). All ACAMS devices are to be compatible with the University's CBORD Access system.

1.2 RELATED WORK:

- A. See the following specification sections for work related to the work of this section:
 - 1. 28 05 00 General Requirements for Safety and Security Systems

1.3 CODES AND STANDARDS:

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

1. California Electrical Code (CEC):
2. Underwriters Laboratories (UL):
 - a. 294 Access Control System Units
3. Federal Communications Commission (FCC):
 - a. FCC Certification
4. International Electrotechnical Commission (IEC):
 - a. 529 Degree of Protection Provided by Enclosures

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.

1.5 SUBMITTAL:

A. As specified in Division 1 and Section 28 0500.

B. Catalog Data: Provide manufacturer's descriptive literature.

C. Submit the following items:

1. Manufacturer's Data: Submit manufacturer's original catalog cuts with sufficient information provided so that the exact function of each device is known and certificates for equipment, and pertinent details for each system specified. Obtain approval before procurement, fabrication, or delivery of the items to the job site. Partial submittals are not acceptable and will be returned without review.
 - a. Information to be submitted includes manufacturer's name, trade name, equipment model number, nameplate data, equipment drawings including: size, layout dimensions and capacity, materials and finish, manufacturer's descriptive literature of cataloged products, diagrams, test data, and performance and characteristic curves as applicable. Furnish 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.
2. Description of conductors to be used with a statement that all wire shall be in conduit.
3. Drawings shall include the following:
 - a. Single-line riser diagram showing all equipment and devices, all connections and number and size of all conductors for the Intrusion Detection System.
 - b. Single-line riser diagram showing all equipment and devices, all connections and number and size of all conductors for the Door Access Control System.

- c. Typical mounting detail drawings for the field devices: motion detectors, break glass detectors, and card key proximity readers.
 - d. Plan drawings showing all equipment locations.
 - e. Coordinate with other applicable trades in submittal of shop drawings.
 - f. Shop drawings shall detail space conditions to accommodate other concerned trades, subject to final review by the architect and University representative.
- D. Submittals are required for all items, regardless of whether they are furnished as specified or are substituted.
- E. Organize submittals for equipment and items related to each specification section together as a package.
- F. Substitutions:
- 1. As specified in Division 1 and Section 28 05 00.
- G. Closeout Submittals:
- 1. Operation and Maintenance Manuals: Furnish 2 O & M Manuals for all equipment. Electrical O & M Manuals shall include as a minimum:
 - a. Individual factory issued manuals, containing all technical information on each piece of equipment installed. In the event such manuals cannot be obtained from a manufacturer, it shall be the responsibility of the Contractor to compile and include them. Advertising brochures shall not be used in lieu of the required technical manuals and information. All manuals shall be printed to ensure their permanence. No "blue line" type of reproduction is acceptable.
 - b. Instruction manuals including operation instructions and maintenance requirements/recommendations. A set of operational procedures for the overall system that includes all required Customer activities and that allows for Customer operation of all system capabilities. This procedure shall fully address all Customer established system operating objectives.
 - c. Warranty for all work, including contractor's general warranty and manufacturer's warranties including any extended warranties, including date of termination and the name and phone number of the person to be called in the event of equipment failure.
 - d. List of suppliers for all equipment with addresses and telephone numbers.
 - e. Copies of all test reports required in specification sections.
 - f. Spare Parts: For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.
 - g. Complete As-Built conduit layout diagrams and wiring diagrams, including complete terminal strip layout and identification, and wire termination and tagging for all conductors. Locations for all major equipment components installed under this specification.

1.6 WARRANTY:

- A. Contactless smart card readers shall be lifetime against defects in materials and

workmanship.

- B. The card shall be warranted against defects in materials and workmanship for two (2) years, or if multiple technologies are used: with a magnetic stripe the card shall have a fifteen (15) month warranty; or with a contact chip, the card shall have a one (1) year warranty.
- C. The key fob shall be warranted against defects in materials and workmanship for two (2) years.

1.7 COORDINATION:

- A. Coordinate the security work with the other trades, code authorities, utilities and the Engineer.
- B. When two trades join together in an area, make certain that no security work is omitted.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Equipment shall bear U.L. label. All materials that make-up a complete system shall be U.L. Listed.
- B. Coordinate wiring type requirements with equipment manufacturers.
- C. Equipment Installation:
 - 1. All active headend equipment for ACAMS, and VSS systems shall be provided by contractor.
 - 2. All card reader devices for ACAMS system shall be provided by contractor.
 - 3. Contractor shall provide all power, wiring, conduit, device installation, and final connections of devices for ACAMS, and VSS systems.
 - 4. Any additional devices, mounting hardware, or miscellaneous appurtenances required to complete fully functional systems for the ACAMS, and VSS systems shall be provided by the contractor.
- D. System Operation:
 - 1. Building shall be capable of being subdivided into multiple zones, each with their own access restrictions.
 - 2. Each zone will include door sensors, local keypad and motion detectors, to prevent unauthorized access.
 - 3. After hours, exterior doors will be monitored via door contacts. Local individual motion detectors inside each door shall temporarily override the associated door contact to prevent alarms when occupants exit after hours but will generate an alarm from unauthorized entry.
 - 4. After hours, all exterior windows on levels accessible from outside will be protected by glass break detection.
 - 5. Digital Alarm Communicator Transmitter (DACT):

- a. Panel shall support use of one or two telephone lines. When using two telephone lines, their use shall be alternated for consecutive events.
- b. DACT shall use Radionics Modem IIIa2 communications format to automatically call remote Commercial Central Station using a Bosch D6500 or D66000 receiver that supports the Radionics Modem IIIa2 communications format. DACT shall transmit Alarms, Troubles and Restorals by point.
- c. Panel shall have capability of communicating with up to 4 phone numbers and/or 4 IP addresses.

E. Security Motion Detectors:

1. The microprocessor shall incorporate supervised, simultaneous passive infrared and microwave detection to activate alarm, with selectable sensitivity.
2. Detector shall incorporate passive infrared (PIR) motion analyzer using multiple thresholds and timing windows to analyze timing, amplitude, duration, and polarity of signals to make an alarm decision. It will not alarm on extreme levels of thermal and illumination disturbances (heaters and air conditioners, hot and cold drafts, sunlight, lightning, and moving headlights). Motion Analyzer II provides two sensitivity settings.
3. Detector shall incorporate microwave pattern recognition circuitry to identify and ignore repetitive false alarm sources. Adaptive processing adjusts to background disturbances. Detector shall provide supervision trouble signal if microwave reflective material is placed within 30.5 cm (1 ft) of detector. System shall provide PIR coverage in the event of a microwave subsystem failure.
4. Three color LED shall provide separate colors for alarm, PIR activation and microwave activation.
5. Dimensions: 5.0 inches x 2.8 inches x 2.2 inches. Operating Temperature 32° F to 120° F. Sealed optic chamber shall provide immunity from drafts and insects.
6. Detectors shall have 50 foot coverage for DS950, and 70 foot coverage for DS970.
7. Provide separately zoned motion detector protection in rooms as shown on the drawings. Contractor to ensure adequate coverage for areas to be protected. Coordinate exact placement of detectors with the architect. Coordinate finish color from standard colors with architect.
8. Manufacturer: Bosch DS950, DS970 or approved equal.

F. Glass Break Detector:

1. Glass break detector shall use microprocessor based Sound Analysis Technology (SAT) to listen for specific frequencies, signature and timing relationships associated with breaking glass to minimize false alarms. Detector shall provide a 25 foot coverage range of breakage of plate, tempered, laminated or wired glass of thicknesses between 1/8" and 1/4" for glass sizes over 12" by 12".
2. To initiate an alarm, detectors shall two distinct frequencies which possess the required signature and timing relationship.
3. Test mode shall include an environmental test for possible false alarm sources caused by ambient noise as well as a magnet operated test for location and operation.
4. Manufacturer: Bosch DS1100i series or approved equal.

G. Door Contacts:

1. Provide heavy duty door contacts compatible with the installed system at all exterior doors.

2.2 WIRE AND CABLE

A. General

1. Provide required wire and cable sized to allow for voltage drop on long runs and effectively shielded as required to allow the routing of 12 & 24V power and video signal cable in the same conduit without interference or signal noise.
2. Cable installed outdoors or in underground conduit must contain a PVC or Polyethylene jacket to prevent water intrusion and compliant with the TIA-455-82B water infiltration test.
3. Cables installed indoors to contain a plenum rated jacket (type CMP).

B. Access Control & Alarm Monitoring System

1. #22/4 AWG unshielded: West Penn #25241B, REX, door contact, alarm device cable, and Knox Box tamper switch.
2. #18/8 AWG shielded (overall): West Penn #253188B, card reader cable for doors over 200' from an IDF/BDF Room.
3. #22/8 AWG shielded (overall): West Penn #253271B, card reader cable for doors within 200' from an IDF/BDF room.
4. #16/2 AWG unshielded: West Penn #25225B, lock power cable for doors over 200' from an IDF/BDF room.
5. #18/2 AWG unshielded: West Penn #25224B, lock power cable for doors within 200' from an IDF/BDF room.
6. #14/2 AWG unshielded: West Penn #25226B, lock power cable from local power booster to exit device
7. #24/4 AWG shielded (overall): West Penn #D4854, RS-485 communications cable

C. Video Surveillance System

1. Cabling for IP cameras provided by Telecommunications contractor. Refer to Section 27 20 00

D. Emergency and Entry Telephone System

1. Voice cabling for entry telephones provided by Telecommunications contractor. Refer to Section 27 30 00

E. Cable Ties

1. General
 - a. Provide Velco-style cable ties on security cabling within telecommunications spaces and covered wireways.
 - b. Dress and bind cabling with cable ties every 24" minimum.
 - c. Width: 0.75 inches
 - d. Color: Black

2.3 VIDEO SURVEILLANCE SYSTEM

- A. Provide a comprehensive and feature rich video surveillance system to monitor the flow of students, employees, and visitors in the stairwell exit doors.
- B. The VSS consists of a network video recorder (NVR), IP cameras and encoded analog cameras. Cameras will utilize the Building's LAN for video transmission and recording. The NVR(s) will reside at UCM Telecom building.
- C. Coordinate video management system software platform with University representative.
- D. Provide enough storage capacity to store videos for a minimum of 3 months with the following minimum requirements:
 - 1. Resolution: 1280 x 720
 - 2. Frame Rate: 15 frames per second
 - 3. Compression: H.264 and MPEG4.
- E. All camera streams and live feeds shall be viewable from the main security desk in the first floor lobby. Provide workstation and display capable of showing all camera views.
- F. Cameras
 - 1. Interior/Exterior Fixed IP Mini-Dome Cameras
 - a. Superior 1.3 megapixel image sensor quality with progressive scan
 - b. Resolution: 12.5 frames per second at 1280x720 and 30 frames per second at 640x480
 - c. Video streaming: Simultaneous MPEG4 and H.264
 - d. Auto iris, varifocal lens of 2.8-8mm
 - e. Security: IP address filtering and HTTPS encryption
 - f. Power Input: 24 VAC, PoE (IEEE 802.3af class 3)
 - g. Connectors:
 - 1) Ethernet 10/100 BaseT, RJ-45
 - 2) Terminal block for alarm inputs, output, and RS-485/422
 - 3) Audio line output, mini-jack
 - h. Vandal resistant dome housing
 - i. Manufacturer:
 - 1) Pelco IDE10DN8-1 Series megapixel network mini-dome camera
 - 2) Or equal
- G. Network 180° IP cameras
 - 1. Sensor: (4) 2-megapixel CMOS sensors
 - 2. Resolution: 6 frames at 6400x1200
 - 3. Video compression format: H.264 and MJPEG
 - 4. Lens: (4) 7.8mm lenses
 - 5. Power over Ethernet (IEEE 802.3af), Class 3
 - 6. Connectors:
 - a. Ethernet 10/100 BaseT, RJ-45
 - b. Terminal block for alarm input and output
 - c. Power - Mini DC
 - 7. Features
 - a. True day/night imager
 - b. Dynamic noise reduction

- c. Programmable back light compensation
 - d. Capable of using onboard intelligent motion detection
 - e. Automatic exposure and gain control functionality
8. Manufacturer
- a. Arecont #AV8185DN-HB 8 megapixel 180° day/night mini-dome camera with heater/blower.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Follow manufacturers' directions in all cases for installation, testing and energizing.
- B. Accurately set, level, support and fasten all equipment.
- C. All batteries shall have the date of installation hand written on the side in a location clearly visible to service personnel.
- D. Install all wiring in conduit.
- E. Wiring shall be separated from other systems and power or Class 1 circuits, including in boxes, conduit, etc.
- F. 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.
- G. Damaged Products: Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain approval from the Engineer before making repairs to damaged products.

3.2 INSTALLATION:

- A. Systems shall be installed by a security systems contractor who shall be a factory authorized installer.

3.3 MAINTENANCE

- A. The Contractor shall employ a factory-trained service organization within 100 miles of the job site. This organization shall have a minimum of five (5) years' experience in servicing integrated Access Control, Alarm Monitoring, CCTV, and Video Badging Systems and equipment.
- B. Fully qualified repair and maintenance personnel shall be available on a twenty-four (24) hour a day basis, three hundred and sixty-five (365) days a year, with four (4) hour maximum response time for service.

- C. Normal service shall be defined as minor repairs and/or adjustments. Service of this nature shall be provided at no cost to the Customer during normal business hours, which are between 8:00 AM and 5:00 PM, Monday through Friday. For service calls requested by phone before 11:00 AM on a weekday, service shall occur on a same-day basis.
- D. Emergency service shall be required for emergencies defined as critical equipment not being functional, and shall be furnished at no cost to the Customer. Emergency service shall respond within a four (4) hour period, twenty-four (24) hours per day, three hundred and sixty-five (365) days a year. A list of critical equipment shall be developed and coordinated by the Customer and the Contractor.

3.4 PROGRAMMING:

- A. The contractor shall program the systems as directed by the University Representative. Coordinate zoning of the system during the shop drawing phase.

3.5 OPERATION TRAINING:

- A. Furnish the necessary trained personnel to provide instructions. The systems shall be demonstrated to the University's representatives, in a 1-day training session for up to 5 persons, the features and functions of the systems. Instruct the University Representative and designated representatives in the proper operation and maintenance of the system. The University Representative shall be provided with two (2) complete sets of training manuals. One DVD video recording of the training session:
 - 1. Arrange with the University's representative the date and times for performing the testing. The University will select date and time for demonstration.

3.6 LABELING

- A. General
 - 1. All equipment enclosures, conduits, security devices, batteries, wires and cables, equipment racks, terminal blocks, relays, patch panels and the termination positions, within the patch panels should be labeled. The labels should coincide with device IDs used on the record drawings. Batteries should be labeled with the month and year they were installed. Coordinate naming convention with University representative prior to installation.
- B. Nameplates
 - 1. Engraved, plastic laminated nameplates, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Use white letters for engraved nameplates and punch for mechanical fasteners.
- C. Labels
 - 1. Wire and Cable Labels:
 - a. Self-laminating adhesive laser labels. Machine printable with a laser printer.
 - b. Cable size: 0.16 – 0.32" OD
 - c. Color: white with black lettering
 - d. Device Labels:

- e. Self-laminating, type on tape, adhesive labels. Use Helvetica 12 pt text

3.7 SECURITY SYSTEM ACCEPTANCE TESTING

- A. Perform a 100% functional test of system aspects to verify correct operation prior to scheduling the final test. The functional test will help to make the final test run smoothly when demonstrating the system's operation to the University and Engineer.
- B. Document the results of the functional test using the approved test forms and submit a copy to the Engineer along with the system activity reports
- C. Perform a final test of the system in the presence of the Engineer and/or University to demonstrate correct operation of the security system.
- D. At a minimum, include these tests:
 - 1. CCTV Recording System Test
 - a. Test the recording system for correct programming, alarm recording, and event retrieval. Verify correct integration with the ACAMS and IDS system for alarm call- up. Test and verify CCTV system viewable from workstations.
 - 2. CCTV Camera Test
 - a. Review cameras for proper coverage, quality of video, etc.
 - 3. Battery and UPS Load Test
 - a. Disconnect AC power to security system equipment to verify battery operation functions and system remains fully operational.

3.8 TESTING:

- A. A checkout report for each piece of equipment shall be prepared by the Contractor and submitted to the Customer, one copy of which shall be registered with the equipment manufacturers. This report shall include a complete listing of every device, the date it was tested and by whom, and the results and date tested (if failure occurred during any previous tests). The final test reports shall indicate that every device tested successfully. Submit two typed copies of the test reports on 8 ½" x 11" papers, in a neatly bound folder to the Customer for approval. Failure to comply with this will result in a delay of final testing and acceptance.
- B. After the testing report and as-built drawings have been approved by the Customer's representative, the completed system shall be tested in the presence of the Customer's representative.
- C. Acceptance of the system shall require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day period with a 99% system on-line reliability. Should major equipment failure occur, the Contractor shall replace component(s) and begin another ninety (90) day test period. This test shall not start until the Customer has obtained beneficial use of the system. If the requirements provided in the paragraph above are not completed within six (6) months after beginning the tests described therein, the Contractor shall replace the

System with another one from approved Manufacturer, and the process shall be repeated until final acceptance of the System and its equipment by the Customer.

- D. Once the final test is complete, each purchased spare component must be inserted into the System and the System tested in potentially affected areas again to insure complete functionality. The original removed parts will become the System spares.
- E. Test all systems and place in proper and specified working order prior to demonstration of the system. The contractor and a factory-trained technician shall test the completed system for proper operation. Testing of major equipment shall be done in accordance with the manufacturer's instructions and the contractors documented, and approved testing procedures. All equipment and power shall be operated and checked to ensure that operation conforms to the contractor's elementary diagrams, wiring diagrams, and specifications. Any system, equipment or wiring failures discovered during this test shall be repaired or replaced before scheduling the final acceptance test.
- F. Notify University's representative in writing, in advance of testing, at least ten (10) working days in advance of testing to prevent delays in construction schedules.
- G. Furnish the necessary trained personnel to perform final acceptance testing. Allow eight hours of time for performing the prescribed testing. Final testing and demonstration of the system shall be in the presence of the University's representative, the architect, the engineer, the contractor, construction manager and representatives of the authorities having jurisdiction. The system shall be demonstrated to perform all the functions specified. The contractor shall record and submit the test results to the University's representatives. All failures discovered during this test shall be reported. The report shall state the reason for the failure and the corrective action taken.
- H. Verification of Performance:
 - 1. Test each system and subsystem. The demonstration is to consist of not less than the following:
 - a. Designate actual location of each component of a system or subsystem and demonstrate its function and its relationship to other components within the system.
 - b. Test the system and subsystems operations by actual Start-Stop/On-Off, Open/Closing, Arming/Disarming cycling showing how to work controls, how to reset devices and how to conduct emergency operating/operations procedures.
 - c. Test communication, signaling and intrusion detection equipment/devices by actual operation of such devices.
 - 2. Systems to be tested are to include, but are not limited to the following:
 - a. UPS and battery power systems for standby operation during primary power failure
 - b. Door monitoring, glass break and motion detection equipment
 - c. Security Camera System digital video monitoring and playback
- I. Upon successful completion of all final tests and before formal system acceptance, the contractor's representative and security system integrator/installer shall each author and sign a letter confirming the successful completion of the testing. Two (2) copies of each letter shall be forwarded to the University's representative.

CLASSROOM AND OFFICE BUILDING 1 RENOVATION
UNIVERSITY OF CALIFORNIA, MERCED
MERCED, CALIFORNIA

Project No.: 908078

END OF SECTION

SECTION 28 31 13

FIRE ALARM AND MASS NOTIFICATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. General:

1. Also referred to as "Fire Alarm System" and "Fire Alarm and Mass Notification System" and "The System" in the drawings and Specifications.
2. It shall be the Contractors responsibility to design and build (construct) a complete and operable fire alarm, smoke detection and mass notification system approved by the Campus Fire Marshal. These specifications and the fire alarm drawings are intended to establish the design criteria for the fire alarm, smoke detection and mass notification system. The fire alarm drawings are intended to provide a schematic representation of the design criteria.
3. The system shall be designed in compliance with NFPA and California Fire Codes, requirements on the drawings and shall meet audibility levels, visual requirements, intelligibility requirements and areas of coverage requirements for fire alarm and mass notification systems per NFPA requirements.
4. The system shall be constructed based on Contractor provided Campus Fire Marshal approved shop drawings.

B. Work included: Labor, design work, drawings, calculations, submittals, materials and equipment necessary to design, submit for approval, and install the system specified under this Section, including but not limited to:

1. Site intertie of system to Network Command Station (NCS).
2. Fire alarm control panel and digital voice command center (FACP).
3. Initiating devices.
4. Fire Alarm Notification devices.
5. Mass Notification devices.
6. Remote Digital Voice Panel (RDVP).
7. Fireman's remote annunciator panel (FRAP).
8. Fire alarm auxiliary equipment control.
9. Record drawings.
10. Pretesting and final testing.

C. Items specified under another Division with connections specified under this Section:

1. Fire sprinkler alarm system flow switches, valve monitors.
2. Elevator controller for recall.
3. Fire/smoke dampers.

D. Equipment and connection to fire alarm system specified under this Section, with installation and connection to HVAC system specified under another Division:

1. Duct mounted smoke detectors and associated programmable relay.

- E. Work specified under another Division: HVAC shutdown wiring via dry contacts in remote mounted programmable relays.
- F. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.
 - 1. Division 14: Elevators.
 - 2. Division 23: HVAC System.
 - 3. Division 21: Fire Sprinkler System
- G. BIM Modeling and Coordination
 - 1. Contractor shall provide BIM modeling of their respective scope of work to establish the routing, layout, and coordination with other trades of their respective work in a BIM 3D model during the submittal process and prior to any installation taking place. Models shall accurately reflect framing size, bracing size, location, orientation, connection details, and work of other trades, etc. The Construction Manager shall provide coordination feedback to all Contractors for complete coordination.
 - 2. See Section 23 05 00 1.01 E Basic Mechanical Materials and Methods for additional information.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meetings:
 - 1. Pre-Installation Conferences: Contractor to conduct meetings at site per the requirements of Division 01 Section "Project Meetings", with installer and all other trades involved prior to fabrication and start of Work. Familiarize installer with conditions at site.
 - 1.

1.3 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. American National Standards Institute, Inc. (ANSI):
 - a. ANSI C62.41; Guide for Surge Voltage in Low-Voltage AC Power Circuits.
 - b. ANSI / ASME A17.1 Safety Code for Elevators and Escalators (1996 edition).
 - 2. National Fire Protection Association (NFPA):
 - a. NFPA 72; National Fire Alarm Code, 2010 Edition.
 - b. NFPA 72; National Fire Alarm Code, 2010 Edition, Chapter 24 Emergency Communications Systems.
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. UL 38; Manually Actuated Signal Boxes for Use with Fire-Protective Signaling Systems.
 - b. UL 268; Smoke Detectors for Fire Protective Signaling Systems.
 - c. UL 268 A; Smoke Detectors for Duct Application.

- d. UL 464; Audible Signal Appliances.
 - e. UL 521; Heat Detectors for Fire Protective Signaling Systems.
 - f. UL 864; Control Units for Fire Protective Signaling Systems.
 - g. UL 1638 Visual Signaling Appliances Standard.
 - h. UL 1971 Signal Devices for Hearing Impaired.
4. Factory Mutual System (FM):
- a. FM P7825 Approval Guide.

1.4 DEFINITIONS

- A. Alarm signal: A signal that indicates a state of emergency requiring immediate notification of the fire department and building occupants.
- B. Supervisory signal: A signal that indicates the impairment of a fire protection system, which may prevent its normal operation.
- C. Trouble signal: A signal that indicates that a fault, such as an open circuit or ground, has occurred in the fire alarm system or in a separate subsystem monitored by the fire alarm system.
- D. ECS Signal: Audio voice message indicating the existence of an emergency situation and communicating information necessary to facilitate an appropriate response and action.
- E. Multiplexing: A signaling method characterized by simultaneous or sequential transmission, or both, and reception of multiple signals on a signaling line circuit, a transmission channel, or a communications channel, including means for positively identifying each signal. The type of system we have specified in this Section is a multiplex addressable type.
- F. Initiating device: A system component that originates transmission of a change of state condition, which initiates an appropriate response via the fire alarm system.
- G. Notification device circuit: A circuit to which notification devices are connected to visually and audibly indicate an alarm signal.
- H. Signaling line circuit: (SLC) A circuit to which any combination of circuit interfaces, control units, or transmitters are connected and over which multiple system input signals or output signals are carried.
- I. Digital Amplifier Loop: (DAL) A circuit in which the digital voice output of the FACP installed "Digital Voice Communication Module" communicates with remote amplifier locations, distributed throughout the building per the floor plan locations.
- J. Class B wiring: A circuit that is monitored for integrity such that a single break, a single wire-to-wire short, or a single loss of carrier condition will be indicated by a trouble signal on the FACP no matter where the break, short or loss of carrier condition occurs, but which would prohibit devices beyond the fault, short or carrier loss from remaining operational. This would be Style 3 wiring for signaling line circuits, Style B for initiating device circuits, and Style Y for notification device circuits.

1.5 SYSTEM DESCRIPTION

- A. The fire alarm system shall be non-coded addressable with Voice Evacuation and shall provide mass notification in the building, in compliance with NFPA 72, 2010 edition requirements. It shall be 24 VDC closed circuit, electronically supervised, common signaling, device indicating, automatic alarm type; operating from manual pull stations, smoke detectors, heat detectors, duct detectors, and sprinkler system switches. The system shall include all wiring, raceways, pullboxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm and supervisory signal initiating devices, alarm notification devices, mass notification devices, and all other accessories required for a complete operating system.
- B. Provide system with the following circuit functions:
1. Class B for initiating device circuits.
 2. Style 4 for signaling line circuits (building).
 3. Style 7 for Network Signaling Line Circuits.
 4. Class B, Style Y for notification device circuits.
- C. Activation of any manual station, water flow switch, heat detector or smoke detector smoke detector in BDF room, IDF room, electrical rooms, elevator machine room, elevator lobbies and inverter room:
1. Cause all audible and visible evacuation alarm devices to sound and/or pulse throughout the system until silenced at the FACP or at the NCS located in the Central Plant.
 2. Display individual addressable initiating device and/or zone number in alarm with a minimum of 80 character alphanumeric display at FACP.
 3. Display the zone of the initiating devices in alarm at the addressable FRAP.
 4. Display on the terminal and printout a hard copy record of the device type, location, status, time and date on printer at the NCS, located in the Dispatch Center at Central Plant.
 5. Transmit alarm signal to remote monitoring station.
 6. Annunciate the signal on the NCS located in the Dispatch Center.
- D. Activation of Mass Notification pre-recorded message, or manual activation of and utilization of remote microphone, (for the purpose of providing information and instructions in a building area or site) shall cause the ECS visual devices to activate, and allow use of the fire alarm speaker system without the fire alarm visual device activation. Mass notification audio shall override fire alarm audio until physically switched back to fire alarm audio.
- E. When in mass notification mode, a supervisory signal shall be sent the NCS at the central plant and a signal shall be sent to the digital network lighting control system via addressable output modules.
- F. Activation of detectors in elevator lobbies, elevator equipment room shall cause elevators to be recalled to ground floor or alternate floor if ground floor detector is in alarm.
- G. Activation of heat detectors in elevator equipment room shall cause the power service to elevator machine room equipment to be automatically disconnected.

- H. Activation of duct smoke detectors or smoke detectors in plenums associated with fan shut down shall shut down associated air handling equipment and provide a supervisory signal only.
- I. Activation of duct smoke detectors associated with fire/smoke dampers shall cause associated and/or programmed dampers to close, shut down the associated fan where indicated on drawings and shall provide a supervisory signal only.
- J. Activation of smoke detectors in restrooms associated with fire/smoke dampers shall cause associated and/or programmed dampers to close and shall provide a supervisory signal only.
- K. Activation of smoke detector in elevator machine room associated with fire/smoke damper and fan shut down shall cause associated and/or programmed dampers to close, and shall shut down the associated fan.
- L. System shall provide supervisory signals for the following:
 - 1. System trouble, consisting of:
 - a. Removal of an initiating device from any circuit.
 - b. An open or ground fault in any initiating circuit.
 - c. An open, short or ground fault in an annunciation circuit.
 - d. A ground fault on any DC line.
 - e. Removal of system input, output, or control modules.
 - f. Improper condition of battery or charger.
 - 2. Activation of duct smoke detectors or smoke detectors in plenums associated with fan shut down.
 - 3. Activation of duct smoke detectors associated with fire/smoke dampers.
 - 4. Activation of smoke detectors in restrooms associated with fire/smoke dampers. Sprinkler valve monitor (tamper) switch.
- M. Failure of any circuit supervised by the FACP shall:
 - 1. Cause the trouble buzzer at the FACP to sound continuously until silenced.
 - 2. Cause the offending addressable device and/or zone to display at the FACP.
 - 3. Cause the offending zone to display the trouble light on the FRAP.
 - 4. Display on terminal and printout on the system printer at NCS, located in the Central Plant.
 - 5. Transmit a trouble signal to remote monitoring station.
- N. Failure of AC power shall:
 - 1. Cause the trouble buzzer at the FACP and NCS (in the Dispatch Central) to sound continuously until silenced.
 - 2. Display condition at the FACP.
 - 3. Display on terminal and printout condition on system printer at the NCS, located in the Dispatch Central.
 - 4. Cause automatic transfer to standby battery. All system functions shall be operational during power failure.

- O. In addition to the above sequence of operation, the FACP shall perform the following functions:
1. Identify every addressable device by location, priority, and device type.
 2. Read and display at FACP the sensitivity of addressable smoke and heat detection devices.
 3. Remain 100% operational and capable of responding to an alarm condition while in the routine maintenance mode.
 4. Be capable of supporting non-addressable as well as addressable devices.
 5. Allow individual programmable control of each connected remote or panel-mounted relay.
 6. Provide the user with the field programmability to add or change addressable device types and custom messages on system terminal at NCS. No fire alarm operational programming shall be encoded without the code being made available to the University.
 7. Display up to 127 alarms and/or up to 127 trouble indications, one at a time, as a list on the system printer/terminal.
 8. Change the status of configured circuits (arming or disarming) and change status of relays.
 9. Generate an addressable detector sensitivity report providing a chamber voltage listing (device testing) for each detector.

1.6 SUBMITTALS

- A. Submit in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, the following items:
1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
 2. Describe system operation, equipment, and dimensions and indicate features of each component.
 3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
 4. Shop drawings:
 - a. Legend of symbols.
 - b. Sequence of operation matrix.
 - c. Plot plans and building floor plans, showing location of all devices and equipment, conduit routing to all devices and equipment, candela rating of all strobe devices, as well as room identifications. Indicate location of rated walls and provide details of conduit penetrations.
 - d. Point-to-point wiring diagram in block or riser format showing all fire alarm components, conduit and wire types and sizes with cable legend.
 - e. Provide 1/4" scale plan of equipment layout in main fire control room.
 - f. Include elevations of control panel and remote annunciator panel(s) as well as pull stations and audible/visual devices.
 5. Submit structural calculations for equipment anchorage as described in Section 26 05 00: Basic Electrical Requirements.
 6. Battery standby calculations showing total standby power needed to meet the specified system requirements.
 7. Voltage drop calculation along all conductors carrying power to devices.
 8. Submit manufacturer's installation instructions.

9. Complete bill of materials listing all components. Provide California State Fire Marshal listing number for each device.
 10. Vendor/supplier qualifications.
 11. Warranty.
 12. Obtain approval of the Fire Marshal prior to submitting to the University's Representative for review.
- B. Submit the items listed in part 1.5, A of this section to the Campus Fire Marshal for review and approval prior to the purchase and installation of equipment.
- C. Contractor (vendor/supplier) preparing the shop drawings shall have a California registered professional electrical engineer stamp and sign all of the shop drawings and front cover of equipment submittal prior to submission to Campus Fire Marshal for final review. Drawings shall be stamped and signed by a NICET Level IV technician certified in the subfield of Fire Alarm Systems.
- D. Deferred Approval Documents: Do not proceed with fabrication or installation of the system until deferred approval documents have been approved by Fire Marshal and University Representative.
1. General: Provide detailed drawings, specifications, and calculations prepared by a State of California licensed professional engineer.
 2. University Representative Review: Make additions, changes and corrections as directed by University Representative and resubmit.
 3. Agency Review: Submit documents to Agency or Authority Having Jurisdiction. Make additions, changes and corrections required by Agency / Authority at no cost to University and resubmit to University Representative.
- E. Record Drawings:
1. Furnish Record Drawings as described in Section 26 05 00: Basic Electrical Requirements, utilizing shop-drawing submissions with updated field conditions. These drawings shall include but not be limited to the following:
 - a. Plot plans and building floor plans, showing point-to-point wiring location of and conduit routing to all devices.
 - b. Block Diagram/Riser Diagram showing the FACP, system components and all conduit and wire type/sizes between each.
 2. Drawings shall be incorporated into the Record Drawing submission.
 3. Final acceptance will not be made until the University's Representative has approved the Record Drawings.

1.7 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 26 05 00: Basic Electrical Requirements, to include the following:
1. A detailed explanation of the operation of the system.
 2. Instructions for routine maintenance.
 3. Pictorial parts list and part numbers.
 4. Schematic drawings of wiring system, including all initiation and annunciation devices, control panel, annunciators, NCS equipment interface, fiber optic cable, etc.
 5. Telephone numbers for the authorized parts and service distributors.

6. Final testing reports.
7. Recommended Spare Parts List

1.8 QUALITY ASSURANCE

A. Vendor/supplier qualifications:

1. The vendor/supplier shall have had at least 10 years successful experience installing building fire alarm systems of similar make and similar model; and in addition shall have successfully installed, on at least 3 prior projects with a value of at least \$150,000, building fire alarm systems, which are comparable to the system required for this project and which have performed satisfactorily under conditions of normal use for a period of not less than one year. To be considered comparable, prior installations shall be of similar size (number of initiating, interface and/or indicating devices) with Central Processing Unit/Fire Alarm Control Panels (CPU/FACP's) of similar size and configuration. Equipment provided shall be by the specified manufacturer. The University may reject any proposed vendor/supplier who cannot show evidence of such qualifications. The services of a technician provided by the fire alarm system equipment manufacturer shall be included to supervise installation, adjustments and tests of the system. Vendor/supplier's providing equipment and/or engineering services must have a minimum of 10 years experience with the manufacture of equipment they are proposing.
2. The vendor/supplier shall furnish evidence that they are an experienced and effective service organization, which carries a stock of repair parts for the system. Service during the warranty period shall be provided within four hours after notification and all repairs shall be affected within twenty-four hours after notification. Should the vendor/supplier fail to comply with the above requirements, the University will then have the option to make the necessary repairs and back-charge the vendor/supplier without any loss of warranty as required by the contract documents. Vendor/supplier shall have in-place support facilities within 75 miles of this site with technical staff, spare parts, inventory and all necessary test and diagnostic equipment.
3. Proof of Competency: Vendor/supplier shall submit a list of prior comparable installations, together with names and addresses of the buildings, the names of the Owners or Managers, telephone numbers and other pertinent information required by the University.
4. Engineering stamp & signature: Vendor/supplier shall employ a California registered electrical engineer or a Level IV NICET Fire Alarm Systems Certified individual to stamp and sign the shop drawings when fully completed for submission to the Campus Fire Marshal.

B. All materials, equipment and parts comprising the units specified herein, shall be new and unused, and of current manufacture.

C. Only products and applications listed in this section may be used on the project unless otherwise submitted.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Fire alarm system components shall not be delivered to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to manufacturer at no additional cost to University.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to manufacturer.

1.10 WARRANTY

- A. Units and components offered under this Section shall be covered by a 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the University.
- B. The warranty package shall include, but not be limited to the following:
 - 1. Emergency maintenance service.
 - 2. Service by factory trained service representative of system manufacturer.
 - 3. Replacement of any defective components.
 - 4. Any work performed on the Campus Network Reporting System must be performed by the current warranty provider. Please contact Tri-Signal Integration at 559-274-1299.

1.11 SYSTEM START-UP

- A. Upon completion of installation, a factory trained dealer service representative shall perform initial start-up of the fire alarm system. Sufficient time shall be allowed to properly check the system out and perform required minor adjustments before the University's Representative witnessed test shall begin.

1.12 MAINTENANCE

- A. Maintenance Service:
 - 1. For a period of one year following acceptance the equipment supplier shall have a person(s) familiar with this project attend four quarterly meetings with the University's representative to review system performance, operation and any system problems. That person shall provide a written summary of the items discussed in each meeting and a schedule of when the system problems will be corrected. The report is due within 7 working days after each meeting.
 - 2. During the eleventh month following system acceptance, on a weekend day, the equipment supplier shall perform a complete test of the system, in a manner similar to the acceptance test. A written report shall be submitted to the University

certifying that each initiating device has been tested. A copy of these test forms shall be submitted to the University's Representative for review and acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Campus standard: Notifier ONYX series.
- B. Equal products will be considered provided that features of the specified products conform to the campus existing system network.

C. NETWORK EQUIPMENT

D. Network media:

1. Fiber optic cable network Style 7 connection shall be required between the CAOB Building FACP to the existing COB Building FACP and to the existing Library Building FACP.
2. The fiber optic cabling from the CAOB Building FACP to the existing COB Building FACP and to the existing Library Building FACP shall be provided under the site communications contract as part of the fiber trunk cabling.
3. Include fiber optic cable termination and interface equipment within the FACP. Notifier #NCM-F network communication module/fiber.

2.2 CONTROL PANEL (FACP)

A. Control panel:

1. The panel shall comply with applicable requirements of UL864 and shall provide power, annunciation, supervision and control for the complete fire alarm system. The panel shall be modular in construction, installed in a surface/flush mounted steel cabinet with hinged door and cylinder lock, containing all modules necessary to operate as indicated herein. Notifier #NFS2-3030 fire alarm control panel with #CPU2-3030D central processing unit and DVC Digital Voice Command Center.
2. Addressable devices shall be individually identified by the system and any quantity of addressable devices may be in alarm at any time up to the total number connected to the system.
3. The panel annunciator shall be a minimum of a Notifier 640 character alphanumeric primary display, which shall provide a user definable custom message associated with each detection device or zone.
4. The time delay between the activation of an initiating device and the automatic activation of local fire safety function shall not exceed 10 seconds.
5. Dynamic supervision of system electronics, wiring, initiating devices and software shall be provided by the control system. Failure of system hardware or wiring shall be indicated by type and location on the alphanumeric annunciator. Software and processor operation shall be monitored by a independent hardware watchdog, which will indicate their failure. The panel shall provide failsafe operation, i.e. all incoming alarms shall override all other modes of operation.

6. Provide a service mode to permit the arming and disarming of individual initiating or output devices as well as manually operating output devices. Status of these devices shall be displayed upon command from the control panel. The panel shall automatically return to the normal mode in the event the panel remains unattended in the service mode.
7. The panel shall be capable of measuring and adjusting the sensitivity of addressable detectors upon request. An alphanumeric display shall be provided to display custom messages and give readings of detector sensitivity detector by detector. Each device on an addressable initiating circuit shall be checked continuously to include the following:
 - a. Sensitivity.
 - b. Response.
 - c. Opens.
 - d. Shorts.
 - e. Ground faults.
 - f. Functionality.
 - g. Status.
8. The panel shall monitor the addressable smoke detectors in such a manner that if the detectors become dirty and reach and maintain 80% of alarm threshold for five (5) consecutive hours, a trouble condition indicating exactly which device needs service shall be automatically annunciated. If the device becomes too insensitive for a period of 10 seconds, the trouble indication will read: "Immediate maintenance required" or similar.
9. The panel shall report, by specific device number, any device removed from an addressable initiating circuit and all other devices shall continue to function.
10. The panel shall automatically indicate the total quantity of alarms and troubles, which have occurred prior to reset at the control unit.
11. No alarm or trouble indication shall be resettable until it has been acknowledged. It shall not be possible to reset the system until all alarms have been acknowledged.
12. The panel shall be capable of:
 - a. Counting the number of addressable devices within a designated area or "zone" which are in alarm.
 - b. Counting "zones" which are in alarm.
 - c. Counting the number of addressable devices, which are in alarm on the system.
 - d. Differentiating among types of addressable devices such as smoke detectors, manual stations, waterflow switches, and heat detectors.
 - e. Assigning priorities to types of devices, zones or groups of devices.
 - f. Cross-Zoning.
13. Each addressable device shall report its condition to the panel control unit every three (3) seconds in a manner such that failure of the connections to or internal electronics of the device will result in a trouble signal that identifies the specific device involved.
14. The panel shall also be capable of operating non-addressable Class A or B initiating circuits.
15. Alarm and trouble from non-addressable initiating circuits (zones) shall be annunciated and cause output functions in the same manner as addressable detection devices including a location message for each zone.

16. Panel output circuits shall be supervised and capable of providing 1.5 amps at 24 VDC.
 17. Provision for programmable control relays in panel shall be included having dry contacts rated 120 VAC, 5 amp inductive.
 18. Programmable remote relays shall be controlled in the same manner as panel mounted relays.
- B. Initiation/notification modules:
1. All modules shall be plug-in, dynamically supervised and easily replaceable. Field wiring shall be connected to the panel with removable multi-conductor connectors to facilitate rapid removal and replacement of both the module and wiring for ease of serving the panel. The modules shall be system interconnected by a card edge connector.
 2. Provide zone input addressable modules for monitoring non-addressable initiating circuits.
 3. Provide programmable signal modules on output circuits for operation of DC audible devices.
 4. Provide, as needed, programmable supplementary relay modules containing four independent relays fitted with form "C" contacts, rated at 120 VAC, 5 amps inductive.
 5. Notifier #LEM-320 loop expansion modules.
- C. Power supply: Adequate to serve FACP modules, initiating devices, annunciating devices, remote annunciators, door hold-open/closure devices, roll-down fire doors or shutters, fire/smoke dampers. Power supplies shall be both internal to FACP and remote as required. All power connections whether AC or DC shall be separately fused within panel. Notifier AMPS-24 and ACPS-610 power supplies.
- D. Storage batteries: Shall be provided and shall be the sealed, nickel-cadmium types. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 24 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm annunciating devices in the total alarm mode for a period of 5 minutes. Battery cabinet shall be a separate compartment within the control panel. Notifier #BP2-4 battery dress panel, #DP-1B blank dress panel, and Power Sonic #PS12260 – 26 AH batteries.
- E. Battery charger: Shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 8 hours. A separate ammeter shall be provided for indicating rate of charge. A separate voltmeter shall be provided to indicate the state of the battery charge. Pilot light shall indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided. Charger shall be located in control panel or battery cabinet.
- 2.3 REMOTE DIGITAL VOICE PANEL (RDVP)
- A. The panel shall be modular in construction, installed in a surface/flush mounted steel cabinet with hinged door and cylinder lock, containing all modules necessary to

operate as indicated herein Notifier EQBB-B4 series backbox with EQDR-B4 door.
This panel shall house the below listed equipment;

- B. DAA2-5025 Remote Digital Amplifier shall be housed in this location on provided chassis with CHS-BH1 Battery Mounting Chassis for (2)-12AH Batteries.
- C. ACPS-610 Addressable Remote visual power supply. For Fire Alarm Strobe and Mass Notification Strobe circuit power.
- D. Batteries – Shall be sized appropriately for 24 hour standby visual appliances. Minimum size 26ah within EQBB-B4. If required battery backup exceeds 26ah, contractor must supply Notifier #NFS-LBB in addition to EQBB.

2.4 ADDRESSABLE INITIATING DEVICES

- A. Manual pull stations: Shall conform to the applicable requirements of UL 38. Addressable manual stations shall be connected into addressable initiating circuits. Stations shall be single action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Control panel shall monitor the station by address and function. The use of a key shall be required to reset the station. Stations shall have a separate screw terminal for each conductor and be capable of field programming for its "address" location on a initiating circuit. Notifier #NBG-12LX interior manual pull station and #NBG-12LOB exterior manual pull station with #IOB-R weatherproof backbox.
- B. Heat detectors: Shall conform to the applicable requirements of UL 521. Addressable detectors shall be electronic designed for detection of fire by combination fixed temperature and rate-of-rise principle. Detectors shall be connected into addressable initiating circuits. All electronics shall be contained within detector head and shall plug-in to terminal base. Detector shall be field programmable and contain external indication that is readily visible. The detector shall be dynamically supervised and individually identified by FACP, as well as sensitivity adjustable. Rating for fixed temperature portion shall be 135 degrees F. Detectors shall have screw terminals in base for making all wiring connection. Notifier #FST-851 thermal detector with #B710LP detector base. Notifier FST-851H 194 degree thermal detector and B710LP base for high ambient heat areas.
- C. Smoke detectors: Shall conform to the applicable requirements of UL 268:
 - 1. Photoelectric detectors: Addressable detectors shall be electronic designed for detection of abnormal smoke densities. Detectors shall consist of separate transmitter and receiver units. The transmitter unit shall emit an infrared beam to the receiver unit. When the signal at the receiver falls below a preset sensitivity, the detector shall initiate an alarm. The receiver shall contain an LED that is powered upon an alarm condition. Long-term changes to the received signal caused by environmental variations shall be automatically compensated. Detectors shall be connected into addressable initiating circuits. All electronics shall be contained within detector head and shall plug-in to terminal base. Detectors shall be field programmable and contain external indication that is readily visible. The detector shall be dynamically supervised and individually identified by FACP, as well as sensitivity adjustable. Detectors shall have multiple sensitivity settings in order to meet UL listings for the different distances covered by the beam.

- Detectors shall have screw terminals in base for making all wiring connections. Notifier #FSP-851 smoke detector with #B710LP detector base
2. Duct smoke detectors: Addressable detector shall have a duct housing, mounted exterior to the duct, and with perforated sampling tubes. Activation of a detector shall cause shutdown of the associated air-handling unit via remote mounted programmable relay module controlled from the FACP. Detectors shall be rated for the air velocity to be expected. Notifier #FSP-851 smoke detector, #B710LP detector base, #DNR – duct smoke detector housing, FSP-851, or FSP-851R (if utilizing remote test station RTS) with #DST5 sampling tube.
 3. In-duct smoke detector: Addressable smoke detector mounted within duct cavity adjacent to FSD access panel for serviceability. Activation of the detector shall cause associated FSD's to close via a remote mounted programmable relay, controlled from the FACP. Detector #FSP-851 smoke detector with #B710LP detector base.
- D. Interface modules: Addressable interface module shall be connected into addressable initiating circuits. This device shall be used for interfacing normally open or normally closed direct shorting contact devices to an addressable initiating circuit (i.e. water flow, tamper switches, non-addressable initiating devices, etc.). Module shall be dynamically supervised and individually identified by FACP. Notifier #FDM-1 dual monitor module, #FMM-1 monitor module, and #FCM-1 control module.
- E. Remote mounted programmable relay modules: Addressable interface module containing a programmable control relay with contacts rated at 2.0 amps at 30VDC, 0.6 amps at 120 VAC. Notifier #FRM-1 relay module, Air Products #PAM-1 stepping relay, and Function Devices #RIB01BDC stepping relay 30AH.

2.5 NOTIFICATION DEVICES

- A. Speakers, strobes and combination speaker/strobes:
1. These units shall be mounted flush in all finished areas and surface mounted in unfinished equipment areas. White enamel grill for units mounted in finished (public) areas; red for units mounted in unfinished (mechanical) areas.
 2. Maximum loading: The loading on both the strobe and audio circuits shall not exceed 75% of its rated capacity. Verify that strobe in-rush currents are safely within the maximum rated capacity of the circuit.
 3. Speaker: Wall or ceiling mounted units shall include a blocking capacitor for line supervision and screw terminals for in-out wiring. The back of the speaker cone shall be covered to protect the cone from damage and dust. The speakers shall operate over a frequency range of 400 - 4000Hz and shall have field selectable power taps of 1/8 to 8 watts with sound output up to 92dBA at 10 feet measured per UL standard 1480 when set on the 8 watt tap. Speaker shall be rated for operation on a 25-volt audio system.
 4. Fire Alarm Strobe: Wall mounted units shall incorporate 15, 30, 75, 110 candela, sync able, strobe lights that flash once per second with 24 VDC input with a maximum current draw of .088 amps. Clear lexan lens with the word "Fire" conforming to UL 1971 and xenon flash tube. Wheelock #RSS-24MCW-FR multi candela strobe.
 5. Fire Alarm Speaker/strobe: Wall mounted units with speaker specifications listed above, and shall incorporate 15, 30, 75 or 110 candela, sync able, strobe lights

- that flash once per second with 24 VDC input with a maximum current draw of .088 amps. Clear lexan lens with the word "Fire" conforming to UL 1971 and xenon flash tube. Wheelock #E70-24MCW-FR multi candela interior speaker/strobe, #ET70WP-2475W-FR weatherproof exterior speaker/strobe with IOB-R weatherproof backbox.
6. Mass Notification Strobe: Wall mounted units shall incorporate 15, 30, 75, 110 candela, sync able, strobe lights that flash once per second with 24 VDC input with a maximum current draw of 0.253 amps (185 candela). Amber lexan lens with the word "Alert" conforming to UL 1638 and UL 1971 with xenon flash tube. Wheelock Exceder Series STW-ALA multi candela strobe. Ceiling mounted units; STWC-ALA multi candela strobe.
 7. Minimum candela rating of fire alarm and mass notification strobes in toilet rooms shall be 15 candela and in classrooms and labs shall be 75 candela.
 8. Remote power supplies for strobe circuits:
 - a. Provide quantity of remote power supplies required for system. Power supplies shall be mounted in hinged NEMA 1 enclosures, maximum 24" wide, with locking handle and the following items:
 - 1) Back-up emergency batteries, sized per NFPA standards. Provide separate enclosure for batteries if required to prevent damage from corrosive gases. Power Sonic #PS1270 – 7AH batteries.
 - 2) Provide a automatic dual rate (high rate and float charge) battery charger capable of recharging batteries to 80% capacity in 8 hours. The charger output shall be supervised and fused.
 - 3) Supervised programmable relays or network interface module to control strobe lights on a floor-by-floor basis.
 - b. Power supplies shall be connected to 120 VAC circuits. Notifier #FCPS-24S8 power supplies.
 - c. If the power supply loses AC power, a system trouble shall occur.
 - d. Locks shall be keyed the same as all other fire alarm control panels.
- B. Synchronization modules: Synchronization modules shall be connected to the notification circuits and shall be used to synchronize the flash rate of strobe devices where more than one strobe can be viewed from a given location in the building. Synchronization shall match Code 3 temporal pattern with a flash rate of 1 Hz, 3 amps at 24 VDC.
- C. Fireman's remote annunciator panel (FRAP): Shall be a slave to the FACP and shall have a two line by 160-character LCD display. Dedicated LED lamps shall light upon activation of any alarm, supervisory or trouble condition and a tone-alert shall sound. The backlit alphanumeric liquid crystal display (LED) shall indicate type of alarm, number of alarms, supervisory conditions, and troubles in the system, and a custom location designation. Annunciator shall include control switches for system acknowledgments, alarm silence and system reset. Information is transmitted to the annunciator over a single twisted, shielded pair cable. Notifier LCD-160 Annunciator shall be flush mounted in NEMA 1 enclosure for interior applications. NFS-3030 applications only.

2.6 AUXILIARY EQUIPMENT CONTROL AND SUPERVISION

- A. Under this Section, provide connections to the following equipment to activate control sequence of operation:
1. Fire sprinkler system components: Provide a pair of wires from a remote mounted addressable interface module (2'-6" maximum wire length) for each of the following devices:
 - a. Each waterflow switch to initiate a alarm signal.
 - b. Each valve monitor switch (tamper switch) to initiate a supervisory signal.
 2. Elevator controller(s): Provide a pair of wires from a set of dry contacts in the FACP or remote mounted programmable relays to elevator controller(s) for each of the following:
 - a. Elevator recall to ground floor.
 - b. Elevator recall to alternate floor designated by fire marshal. Alternate floor contacts will activate if ground floor detector is in alarm.
 3. Fire/smoke dampers: Provide a pair of wires from a set of dry contacts in the remote mounted programmable relays to each fire/smoke damper for automatic closure of dampers.

2.7 VOICE COMMUNICATION SYSTEM

- A. Digital voice command center (DVC):
1. The digital voice command center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset. Notifier #DVC-EM.
 2. Function: The voice command center equipment shall perform the following fire alarm/mass notification functions:
 - a. Operate as a supervised multi-channel emergency voice communication system.
 - b. Operate as a two-way emergency telephone system control center.
 - c. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
 - d. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
 - e. Provide all-call emergency paging activities through activation of a single control switch. (Fire alarm or Mass Notification)
 - f. As required, provide vectored paging control to specific audio zones via dedicated control switches.
 - g. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
 - h. Provide a software utility capable of off-line programming for the VCC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the VCC shall not inhibit the emergency operation of other nodes on the fire alarm network.

- i. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SCL controlled switching.
 - j. The digital voice command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
 - k. The digital voice command and associated equipment shall be protected against unusually high voltage surges or line transients.
- B. Power supply:
1. The addressable main power supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.
 2. The addressable main power supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.
 3. The addressable main power supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 25-200 amp-hours within a 48-hour period.
 4. The addressable main power supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
 5. The addressable main power supply shall be power-limited per UL864 requirements.
- C. System circuit supervision:
1. The FACP shall supervise all circuits to intelligent devices, transponders, annunciators and peripheral equipment and announce loss of communication with these devices. The CPU shall continuously scan above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate which device or devices are not responding and print the information in the history buffer and on the printer.
 2. Transponders that lose communication with the CPU shall sound an audible trouble and light an LED indicating loss of communications.
 3. Sprinkler system valves, standpipe control valves, and main gate valves shall be supervised for off-normal position.
 4. All speaker and emergency phone circuits shall be supervised for opens and shorts. Each transponder speaker and emergency phone circuit shall have an individual ON/OFF indication (green LED).
- D. Field wiring terminal blocks: All wiring terminal blocks shall be the plug-in/removable type and shall be capable of terminating up to 12 AWG wire. Terminal blocks that are permanently fixed to the PC board are not acceptable.
- E. Audio amplifiers:
1. The audio amplifiers will provide audio power (@25 volts RMS) for distribution to speaker circuits. Notifier DAA2-5025(),(F),(SF) indicates connection for Digital Amplifier Loop control circuit (wire or fiber).

2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
 3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:
 - a. Earth fault on DAP A (digital audio port A).
 - b. Earth fault on DAP B (digital audio port B).
 - c. Audio amplifier failure detected trouble.
 - d. Active alarm bus input.
 - e. Audio detected on aux input A.
 - f. Audio detected on aux input B.
 - g. Audio detected on firefighter's telephone riser.
 - h. Receiving audio from digital audio riser.
 - i. Short circuit on speaker circuit 1.
 - j. Short circuit on speaker circuit 2.
 - k. Short circuit on speaker circuit 3.
 - l. Short circuit on speaker circuit 4.
 - m. Data transmitted on DAP A.
 - n. Data received on DAP A.
 - o. Data transmitted on DAP B.
 - p. Data received on DAP B.
 - q. Board failure.
 - r. Active fiber optic media connection on port A (fiber optic media applications).
 - s. Active fiber optic media connection on port B (fiber optic media applications).
 - t. Power supply earth fault.
 - u. Power supply 5V present.
 - v. Power supply conditions – brownout, high battery, low battery, charger trouble.
 4. The audio amplifier shall provide the following built-in controls:
 - a. Amplifier address selection switches.
 - b. Signal silence of communication loss annunciation reset.
 - c. Level adjustment for background music.
 - d. Enable/disable for earth fault detection on DAP A.
 - e. Enable/disable for earth fault detection on DAP B.
 - f. Switch for 2-wire/4-wire FFT riser.
 5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
 6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
 7. System shall be capable of backup digital amplifiers.
- F. Audio message generator (prerecorded voice)/speaker control:
1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
 2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.

3. A built-in microphone shall be provided to allow paging through speaker circuits.
 4. System paging from emergency telephone circuits shall be supported.
 5. The audio message generator shall have the following LED indicators to allow for proper operator understanding:
 - a. Lamp test.
 - b. Trouble.
 - c. Off-line trouble.
 - d. Microphone trouble.
 - e. Phone trouble.
 - f. Busy/wait.
 - g. Page inhibited.
 - h. Pre/post announcement tone.
- G. Speaker switch controls with associated LED indicators:
1. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
 2. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.
- H. The Notifier DVC Digital Voice Command system shall be provided in order to ensure communication with the Campus Emergency Notification System.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine site conditions for acceptance of fire alarm system installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 INSTALLATION

A. General:

1. Install fire alarm and mass notification systems in accordance with manufacturer's written instructions, as shown on Contractor designed Campus Fire Marshal approved shop drawings and as specified herein. Install all devices in accordance with the requirements of their listing.
2. The 120/208-volt, 3 wire, 60 cycles AC two-20A circuit supply required to power the system shall be connected as shown on the Drawings. Connect to red colored circuit breaker(s) in panelboard. Identify circuit as "Fire Alarm Circuit Control."

B. Wiring:

1. Refer to Section 26 05 19 Building Wire and Cable.
2. Interior Building Cabling:
 - a. Signaling Line Circuits (SLC) wire shall be #16 awg copper, jacketed, unshielded twisted pair (West Penn 990-or equivalent)
 - b. Audio / Speaker output circuits wire shall be #16 awg copper, jacketed, shielded twisted pair (if run in same conduit as SLC) (West Penn 991-or

- equivalent). If run in dedicated speaker conduit can be same as SLC (West Penn 990-or equivalent).
- c. Fire Alarm Strobe /Mass Notification Strobe wiring shall be #12 awg copper, stranded THHN/THWN.
 - d. Digital Amplifier Loop (DAL) wire shall be #16 awg copper, jacketed, unshielded twisted pair (West Penn 990-or equivalent)
3. Underground Building Cabling:
 - a. SLC - #16 copper, UG rated unshielded twisted pair (West Penn AQ225)
 - b. Strobe - #12 THWN copper, rated for wet locations.
 - c. Digital Amplifier Loop - #16 copper, UG rated unshielded twisted pair (West Penn AQ225)
 4. SLC and DAL circuits between FACP and RDVPS shall be dedicated circuits in separate conduits.
 5. Individual input and output device addressability as well as remote sensitivity measurement, supervision and power shall all be performed on the same pair of wires. Wiring shall be Class B.
 6. Each Class B initiating circuit shall consist of a two wire circuit and not requiring any end-of-line device for supervision. Each signaling line circuit shall accommodate up to one hundred forty nine (149) addressable programmable initiating devices. On the initial installation, 70% capacity allowed per SLC circuit to allow for future expansion.
 7. Wiring for shielding certain conductors from others or routing in separate raceways, shall be as recommended by the manufacturer's current requirements.
 8. All wiring shall be installed in a continuous steel conduit system, minimum 3/4 inch trade size and shall be of the size recommended by the equipment supplier. Refer to Section 26 05 33 Conduit.
 9. Wire color-coding shall remain the same throughout the system.
 10. No wiring other than that directly associated with fire alarm detection, alarms, or auxiliary fire protection functions (no 120 VAC), shall be permitted in fire alarm conduits.
 11. Make conduit and wiring connections to sprinkler flow switches, sprinkler valve monitors, fire/smoke dampers, elevator controller.
 12. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.
 13. All fire alarm junction boxes shall be color-coded and marked per section 26 05 54 Electrical Identification.
 14. Wire nut splices are not allowed. All wiring must be connected device to device or in an approved junction box/terminal cabinet on terminals.
 15. Wires shall be numbered at each connection, termination and junction point. Wire numbering tags shall be Brady Perma-Code, Westline, or equal wire makers. Each group of wires shall be tagged with its destination at each panel, terminal box or junction box.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's field service: Arrange and pay for the services of a factory-authorized service representative to supervise the initial start-up, pretesting and adjustment of the fire alarm system.

- B. Independent testing: Arrange and pay for the services of an independent testing agency to perform all quality control electrical testing, calibration and inspection required herein. Testing agencies objectives shall be to:
 - 1. Assure fire alarm system installation conforms to specified requirements and operates within specified tolerances.
 - 2. Field test and inspect to insure operation in accordance with manufacturer's recommendations and specifications.
 - 3. Prepare final test report including results, observations, failures, adjustments and remedies.
 - 4. Apply label on fire alarm system control panel upon satisfactory completion of tests and results.
 - 5. Verify settings and make final adjustments.

- C. University's Representative witnessed testing: Allow a period of 8 hours for University's Representative review and final check.

- D. At least three weeks prior to any testing, notify the University's Representative so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the University's Representative witnessed test.

- E. Commissioning: Comply with the requirements of Section 01 91 00 - Commissioning.

- F. Prefunctional testing:
 - 1. Provide testing agency with contract documents and manufacturer instructions for installation and testing.
 - 2. Visual and mechanical inspection:
 - a. Inspect for physical damage, defects alignment and fit.
 - b. Perform mechanical operational tests in accordance with manufacturer's instructions.
 - c. Compare nameplate information and connections to contract documents.
 - d. Check tightness of all control and power connections.
 - e. Check that all covers, barriers, and doors are secure.
 - 3. Electrical tests:
 - a. The system shall be completely tested prior to final acceptance testing. All points shall be tested from point of initiation to the final point or points of annunciation. All circuits shall be tested for continuity and ability to transmit the required signal correctly to the FACP. Any problem due to wrong wire type, wire twist, impedance, mismatches, noise filtering or shielding shall be completely corrected during pretesting and prior to any final acceptance tests.
 - b. Testing shall include each and every device in the system. Coordinate with other trades as necessary for testing.
 - 1) Sprinkler flow switches: Record time delay from water flow to alarm and adjust as necessary for a 30-50 second delay.
 - 2) Tamper switches: Verify "trouble" signal is received and alarmed on closing of each valve.
 - 3) Smoke detectors, in-duct smoke detectors and duct mounted smoke detectors: Test with actual or approved artificial smoke. Verify that reset does not occur when devices are cleared of smoke. Verify

- supervisory circuit function. Perform pressure differential test on all duct mounted sampling type smoke detectors.
- 4) Elevator recall: Verify that elevators recall to designated floor by testing elevator lobby detectors with smoke. This is necessary on the ground floor and one other only.
 - 5) Audible/visual notification: Activate by means of an alarm-initiating device that audible and visual devices are clearly audible and/or visual throughout.
 - 6) Central station notification: Verify that one set of conductors in the terminal cabinet becomes a short circuit on any "trouble" condition and that the other set becomes a short circuit on any "alarm" condition. Verify that the conductor groups are labeled properly. Central station reporting must conform with University standards.
- c. Test report:
- 1) Provide a complete report listing every device, the date it was tested, the results and the date retested (if failure occurred during the previous test). The test report shall indicate that every device tested successfully.
 - 2) Submit two typed copies of the test report in a neatly bound folder for review and approval. Failure to comply with this will result in a delay of final testing and acceptance.
- G. Functional performance testing:
1. After the approval of the test report, provide a schedule of final testing to be done in the presence of the Fire Marshal and University's Representative and University's Representative. The schedule must be received by the University's Representative a minimum of 3 weeks prior to the Final Test Date and must list the dates and time slots in which the various systems can be tested.
 2. All functional testing shall be conducted as per NFPA 72, Maintenance and Testing requirements.
 3. Coordination of the Final Test dates with all parties shall be the sole responsibility of the Contractor. If a party is required to be present during any phase of testing to activate a device, ensure that the party or a qualified representative of the party is present throughout that phase of the testing.
- H. In the event that the system fails to function properly during the testing as a result of inadequate pretesting or preparation. The contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the University Representative's hourly rate.
- I. Replace at no additional costs to the University all devices, which are found defective or do not operate within factory specified tolerances.
- J. Submit the testing agency's final report for review prior to project closeout and final acceptance by the University. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

3.4 TRAINING

- A. Refer to Specification Section 01 79 00 Training.
- B. Factory authorized service representative shall conduct an 8 hour training seminar for University's Representatives upon completion and acceptance of system. Instructions shall include safe operation, maintenance and testing of equipment with both class-room training and hands-on instruction.
- C. Contractor shall schedule training with a minimum of 7 days advance notice.

END OF SECTION

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