State of Utah–Department of Administrative Services

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT

4110 State Office Building/Salt Lake City, Utah 84114/538–3018

Woodbury School of Business Remodel

UTAH VALLEY UNIVERSITY
OREM, UTAH

DFCM Project # 09171790

Construction Documents Specifications

February 16, 2010

MJSA ARCHITECTURE INTERIOR DESIGN SALT LAKE CITY, UTAH

DFCM-UVU WOODBURY SCHOOL OF BUSINESS REMODEL

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SECTION 01100 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work under separate contracts.
5. Access to site.
6. Coordination with occupants.
7. Work restrictions.
8. Specification and drawing conventions.

B. Related Section:

1. DFCM General Conditions

2. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: UVU Woodbury School of Business Remodel.

B. Project Location: 800 West University Parkway, Orem, UT 84058.

C. Owner: Utah Valley University.

1. Owner's Representative:

a. Mike Ambre, DFCM, 801-538 3018 mailer-daemon@state.ut.us
b. Jim Michaelis, UVU, 801-863 8996 michaelji@uvu.edu

D. Architect: MJSA Architects, 357 West Pierpont Avenue, Salt Lake City, Utah 84101.

E. This project is a TAX EXEMPT project.

F. Refer to DFCM General Conditions for more information pertinent to construction procedures

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and consists of the following:

1. Work of the Project: the scope of work is entirely interior: demolition and addition of walls, new finishes in selected spaces totaling 13,856 square feet. The occupancy classification is B, the construction type IIB. The building is a column and beam concrete structure with PT slabs.

B. Type of Contract.

1. Project will be constructed under a single prime contract.

1.4 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

C. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to areas within the Contract limits indicated.
2. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

   a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.5 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.6 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 7:00p.m., Monday through Saturday, except as otherwise indicated.

1. Unless coordinated with owner in due time.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than two (2) days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two (2) days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.

F. Controlled Substances: Use of tobacco products and other controlled substances within the existing building is not permitted.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 1 General Requirements: Requirements of Sections in Division 1 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01100

SECTION 01210 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.

C. Related Sections:

1. Division 1 Section "Unit Prices" for procedures for using unit prices.
2. Division 1 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.2 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.3 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

C. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

D. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.4 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.5 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include freight, and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner and/ or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.6 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation**, taxes**, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Lump-Sum Allowance: $ 25,000.00 for "WOODBURY WALL" (donor recognition)

1. This allowance includes material cost, receiving, handling, installation, and Contractor overhead and profit.

B. Allowance No. 2: Lump-Sum Allowance: $ 15,000.00 for "FACULTY AND STAFF " (Faculty and Staff recognition)

END OF SECTION 01210

SECTION 01230 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1 - Provide new ceiling finishes and associated electrical and mechanical work as described in contract drawing in room "Lecture 105 & 123". See drawings AD1-01, AD1-11, AE1-01, and AR1-01.

B. Alternate No 2 – Provide new casework for smart lecterns in room #105, #123, and #126 to match new casework for smart lectern in room #125. Existing casework to be salvaged and returned to owner. See drawings AD1-01, AE1-01, AE4-01, and AE5-11.

C. Alternate No 3 – Provide new carpet, base, paint, ceiling and lighting in academic advisor's offices: room #257A-257G." See drawings AD1-02, AD1-12, AE1-02, and AR1-02.

D. Alternate No 4 – Provide new carpet tile and coved rubber base in Corridors 101J, 101K, 101L, 200A, 200B, 200C, 200D and 200E. See drawings AE1-01, AE1-02, and AE6-01.

END OF SECTION 01230

SECTION 01524 - CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Sections:

1. Division 1 Section "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
2. Division 2 Section "Building Demolition" for disposition of waste resulting from demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
3. Division 2 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.
4. Division 4 Section "Unit Masonry Assemblies" for disposal requirements for masonry waste.
5. Division 4 Section "Stone Masonry" for disposal requirements for excess stone and stone waste.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

1.4 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 1 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:

1. to be determined.

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

   a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Grind asphalt to size to be determined.

B. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to size to be determined.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to size to be determined.
2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

J. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

K. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

L. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

M. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

D. Disposal: Transport waste materials and dispose of at designated spoil areas on Owner's property.

E. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 01524

SECTION 01700 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Sections:

1. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
2. Division 7 Section "Through-Penetration Firestop Systems" for patching penetrations in fire-rated construction.

1.2 QUALITY ASSURANCE

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

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from the Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner

that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.3 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 1 Section "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. Building Lines and Levels: Locate and lay out control lines and levels for structures, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

C. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Adjacent Occupied Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Division 1 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01700

SECTION 01732 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. See Division 1 Section "Construction Waste Management" for disposal of demolished materials.

C. See Division 2 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. 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 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each activity, interruption of utility services, use of elevator and stairs, and locations of temporary partitions and means of egress.

B. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 1 Section "Photographic Documentation." Submit before Work begins.

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

1. Comply with submittal requirements in Division 1 Section "Construction Waste Management."

1.4 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

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

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Predemolition Conference: Conduct conference at Project site.

1.5 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.

1. Before selective demolition, Owner will remove the following items:

a. To be determined

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is unknown whether 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.

1.6 WARRANTY

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. 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.

E. 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 or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs.

   1. Comply with requirements specified in Division 1 Section "Photographic Documentation."

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

   1. Arrange to shut off indicated utilities with utility companies.
   2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass

area of selective demolition and that maintain continuity of services/systems to other parts of building.

3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Division 1 Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

C. 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

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly. Comply with requirements in Division 1 Section "Construction Waste Management."

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's storage area designated by Owner.
5. 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. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 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 and legally dispose of them in an EPA-approved landfill.

1. Comply with requirements specified in Division 1 Section "Construction Waste Management."

B. Burning: Do not burn demolished materials.

C. 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. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 01732

SECTION 01820 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. At completion of training, submit complete training manual(s) for Owner's use.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Operations manuals.
    c. Maintenance manuals.
    d. Project record documents.
    e. Identification systems.
    f. Warranties and bonds.
    g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.

e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 1 Section "Operations and Maintenance Data."

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.

C. Narration: Describe scenes on video recording by audio narration by microphone while dubbing audio narration or off-site after video recording is recorded. Include description of items being viewed.

D. Pre-Produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 01820

SECTION 03301 - MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

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

B. Other Action Submittal:

1. Design Mixtures: For each concrete mixture.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Comply with ACI 301.

C. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

PART 2 - PRODUCTS

2.1 FORMWORK

A. Furnish formwork and formwork accessories according to ACI 301.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, Type III.

   a. Fly Ash: ASTM C 618, Class C or F.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregate: ASTM C 33, graded, 1-1/2-inch nominal maximum aggregate size.

C. Water: ASTM C 94/C 94M.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 RELATED MATERIALS

A. Vapor Retarder: Plastic sheet, ASTM E 1745, Class A or B.

B. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 CONCRETE MIXTURES

A. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.

1. Lap joints 6 inches and seal with manufacturer's recommended adhesive or joint tape.

3.4 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Contraction Joints in Slabs-on-Grade: Form weakened-plane sawed contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness.

C. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.6 CONCRETE PLACEMENT

A. Comply with ACI 301 for placing concrete.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

C. Do not add water to concrete during delivery, at Project site, or during placement.

D. Consolidate concrete with mechanical vibrating equipment.

3.7 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests: Perform according to ACI 301.

1. Testing Frequency: One composite sample shall be obtained for each day's pour of each concrete mix exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: One composite sample shall be obtained for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.

3.10 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 03301

SECTION 05730 - ORNAMENTAL FORMED METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Stainless steel benches

2. Stainless steel railings

B. Related Sections:

1. Division 6 Section "Rough Carpentry" for bench support structure

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Decorative formed metal items, including anchors and connections, shall withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components:

1. Live Loads: 100 lbf/sq. ft. or a concentrated load of 300 lbf on an area of 4 sq. in., whichever produces the greater stress.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative formed metal.

1. Include plans, elevations, component details, and attachments to other work.

2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- square Samples of metal of same thickness and material indicated for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and fabricator.

B. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

C. Welding certificates.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: to be included in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative formed metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Installer Qualifications: Fabricator of products.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.6, "Structural Welding Code - Stainless Steel."

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups for the following types of decorative formed metal:

a. Stainless steel bench.

b. Stainless steel rails

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 COORDINATION

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

B. Coordinate installation of decorative formed metal with adjacent construction to ensure that assemblies, trim, and joint sealants, are protected against damage from the effects of corrosion and other causes.

PART 2 - PRODUCTS

2.1 SHEET METAL

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316, stretcher-leveled standard of flatness.

C. Pipe: ASTM A 312/A 312M, Grade TP 304

2.2 MISCELLANEOUS MATERIALS

A. Sealants, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in decorative formed metal; and as recommended in writing by decorative formed metal manufacturer.

B. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.

1. Use filler metals that will match the color of metal being joined and will not cause discoloration.

C. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting decorative formed metal items and for attaching them to other work unless otherwise indicated.

D. Nonstructural Anchors: For applications not indicated to comply with design loads, provide powder-actuated fasteners metal expansion sleeve anchors or metal-impact expansion anchors of type, size, and material necessary for type of load and installation indicated, as recommended by manufacturer, unless otherwise indicated.

E. Anchor Materials:

1. Material Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

F. Backing Materials: Provided or recommended by decorative formed metal manufacturer.

G. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal and that will prevent telegraphing and oil canning and is compatible with substrate and noncombustible after curing.

H. Isolation Coating: Manufacturer's standard.

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to shapes indicated, place joints as indicated on drawings. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- wide hem on the concealed side, Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

D. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce decorative formed metal items as needed to attach and support other construction.

E. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.

F. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

2.4 METAL-CLAD BENCHES

A. Laminate metal sheets, of type and thickness indicated below, to faces of woood base structure where indicated:

1. Stainless-Steel Sheet: 0.038 inch.

a. Finish: No. 6.

2.5 GENERAL FINISH REQUIREMENTS

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

B. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

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

D. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

E. 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.

2.6 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Dull Satin Finish: No. 6.

C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.7 FASTENERS

A. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.

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

3.2 INSTALLATION

A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Install joint fillers and sealants as the Work progresses.

E. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 ADJUSTING AND CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 05730

SECTION 06100 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Wood blocking, cants, and nailers.
3. Wood furring.
4. Plywood backing panels.

B. Related Requirements:

1. Division 5 Section "Ornamental Formed Metal" for bench structures
2. Division 6 Section "Architectural Woodwork" for cabinets blocking and donor wall support

1.3 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

C. Timber: Lumber of 5 inches nominal or greater in least dimension.

D. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NLGA: National Lumber Grades Authority.
2. SPIB: The Southern Pine Inspection Bureau.
3. WCLIB: West Coast Lumber Inspection Bureau.
4. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

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

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

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

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

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

C. Application: Treat all rough carpentry unless otherwise indicated.

1. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED MATERIALS

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

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.

2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

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

E. Application: Treat all rough carpentry unless otherwise indicated.

1. Concealed blocking.
2. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

2.5 MISCELLANEOUS LUMBER

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

1. Blocking.
2. Nailers.
3. Cants.
4. Furring.

B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber of any species.

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

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

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

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

2.7 FASTENERS

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

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

B. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

D. Do not splice structural members between supports unless otherwise indicated.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

1. Comply with approved fastener patterns where applicable.

2. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and vertically at 24 inches o.c. or as indicated

END OF SECTION 06100

SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior standing and running trim.
2. Flush wood paneling.
3. Interior ornamental work.
4. Plastic-laminate cabinets.
5. Solid surfacing countertops.
6. Shop finishing of interior woodwork.
7. Acrylic sheet at donor wall

B. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 5 Section "ornamental formed metal."

1.3 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.

1.4 ACTION SUBMITTALS

A. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate fire-retardant-treated materials cabinet hardware and accessories and finishing materials and processes.

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

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes.
4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples for Initial Selection:

1. Shop-applied transparent finishes.
2. Shop-applied opaque finishes.
3. Plastic laminates.
4. PVC edge material.
5. Thermoset decorative panels.
6. Solid-surfacing materials.
7. Acrylic panel

D. Samples for Verification:

1. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
2. Veneer-faced panel products with or for transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.
3. Lumber and panel products with shop-applied opaque finish, 50 sq. in. for lumber and 8 by 10 inches for panels, for each finish system and color, with 1/2 of exposed surface finished.
4. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
5. Thermoset decorative-panels, 8 by 10 inches, for each type, color, pattern, and surface finish, with edge banding on 1 edge.
6. Corner pieces as follows:

    a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
    b. Miter joints for standing trim.

7. Exposed cabinet hardware and accessories, one unit for each type and finish.
8. Solid-surfacing materials, 6 inches square.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Product Certificates: For each type of product, signed by product manufacturer.

1.6 QUALITY ASSURANCE

A. 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.

1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.

B. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

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. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. 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.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Division 8 Section "Door Hardware (Scheduled by Describing Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

A. Available Fabricators: Subject to compliance with requirements, fabricators offering interior architectural woodwork that may be incorporated into the Work include, but are not limited to, the following:

1. Devereaux Custom Woodworking
2. Fetzer Architectural Woodwork
3. Fondell Architectural Woodwork
4. Granite Mill and Fixture
5. Huetter Mill and Cabinet
6. Thompson and Son
7. Wavell Huber

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. Wood Species and Cut for Transparent Finish: White oak, rift sawn or cut.

C. Wood Species for Opaque Finish: Any closed-grain hardwood.

D. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
3. Particleboard: ANSI A208.1, Grade M-2.
4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

E. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.

F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:

a. Abet Laminati, Inc.
b. Formica Corporation.
c. Nevamar Company, LLC; Decorative Products Div.
d. Wilsonart International; Div. of Premark International, Inc.

G. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

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

a. ABA Industries.
b. Avonite, Inc.
c. E. I. du Pont de Nemours and Company.
d. Formica Corporation.
e. LG Chemical, Ltd.
f. Meganite Inc.; a division of the Pyrochem Group.
g. Nevamar Company, LLC; Decorative Products Div.
h. Samsung; Cheil Industries Inc.
i. Swan Corporation (The).
j. Transolid, Inc.
k. Wilsonart International; Div. of Premark International, Inc.

2. Type: Standard type, unless Special Purpose type is indicated.
3. Colors and Patterns: Match Architect's samples. (Wilsonart Gibraltar Natural Almond D30SL)

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.

1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:

1. Interior Type A: Low-hygroscopic formulation.
2. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking plant certified by testing and inspecting agency.
3. Kiln-dry materials before and after treatment to levels required for untreated materials.

C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.
2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi; modulus of elasticity, 250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.
3. Product: Subject to compliance with requirements, provide "Duraflake FR" by Weyerhaeuser.

D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

1. Product: Subject to compliance with requirements, provide "Medite FR" by SierraPine Ltd.; Medite Div.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware (Scheduled by Describing Products)."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.

C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

D. Catches: Magnetic catches, BHMA A156.9, B03141.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Shelf Rests: BHMA A156.9, B04013; metal.

G. Drawer Slides: BHMA A156.9, B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
2. Box Drawer Slides: Grade 1; for drawers not more than 6 inches high and 24 inches wide.
3. File Drawer Slides: Grade 1HD-100; for drawers more than 6 inches high or 24 inches wide.
4. Pencil Drawer Slides: Grade 2; for drawers not more than 3 inches high and 24 inches wide.
5. Keyboard Slides: Grade 1; for computer keyboard shelves.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Grommets for Cable Passage through Countertops: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Adhesive for Bonding Plastic Laminate: Contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.

E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. 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.

F. Shop-cut openings to maximum extent possible to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.7 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Grade: Custom.

B. Wood Species: Any closed-grain hardwood.

C. Backout 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.

2.8 FLUSH WOOD PANELING

A. Grade: Custom.

B. Wood Species and Cut: White oak, rift cut or as indicated.

1. Lumber Trim and Edges: At fabricator's option, trim and edges indicated as solid wood (except moldings) may be either lumber or veneered construction compatible with grain and color of veneered panels.

C. Matching of Adjacent Veneer Leaves: Slip match.

D. Veneer Matching within Panel Face: Balance match.

E. Panel-Matching Method: Match panels within each separate area by the following method:

1. Premanufactured sets used full width as indicted.

F. Fire-Retardant-Treated Paneling: Provide panels consisting of wood veneer and fire-retardant particleboard or fire-retardant medium-density fiberboard. Panels shall have flame-spread index of 25 or less and smoke-developed index of 450 or less per ASTM E 84.

2.9 INTERIOR ORNAMENTAL WORK FOR TRANSPARENT FINISH

A. Interior ornamental work for transparent finish includes the following:

1. Grilles.(slat wall at donor wall)

B. Grade: Custom.

C. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building, unless otherwise indicated.

2.10 PLASTIC-LAMINATE CABINETS

A. Grade: Custom.

B. AWI Type of Cabinet Construction: Flush overlay and as indicated.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGL.
2. Vertical Surfaces: Grade VGS.
3. Edges: Grade VGS.

D. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.

   a. Edges of Plastic-Laminate Shelves: PVC edge banding,0.12 inch thick, matching laminate in color, pattern, and finish.
   b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.

2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Match Architect's sample.

G. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.11 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Custom.

B. Solid-Surfacing-Material Thickness: 3/4 inch

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. [Match Architect's sample (Wilsonart Gibraltar Natural Almond D30SL)

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.

E. Drill holes in countertops for grommets on site and as indicated by owner or architect. Assume one hole for every three lineal feeet of countertop..

2.12 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 9 painting Sections for finishing opaque-finished architectural woodwork.

D. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Division 9 painting Sections for finishing architectural woodwork not indicated to be shop finished.

E. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. Refer to Division 9 painting Sections for material and application requirements.

F. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

G. Transparent Finish:

1. Grade: Custom.
2. AWI Finish System: Catalyzed lacquer.
3. AWI Finish System: Conversion varnish.
4. Staining: Match Architect's sample.
5. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
6. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.

   a. Apply wash-coat sealer after staining and before filling.

7. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

H. Opaque Finish:

1. Grade: Custom.
2. AWI Finish System: Conversion varnish.
3. Color: Match Architect's sample.
4. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523.

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. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. 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.

C. 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.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. 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.

F. 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.

G. 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 60 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.

H. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening, unless otherwise indicated.

1. Install flush paneling with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

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.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with toggle bolts through metal backing or metal framing behind wall finish.

J. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

K. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

L. Refer to Division 9 Sections for final finishing of installed architectural woodwork not indicated to be shop finished.

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 06402

SECTION 07841 - THROUGH-PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

B. Related Sections:

1. Division 7 Section "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 ACTION SUBMITTALS

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

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:

   a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
   b. Classification markings on penetration firestopping correspond to designations listed by the following:

      1) UL in its "Fire Resistance Directory."

1.6 PROJECT CONDITIONS

A. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. A/D Fire Protection Systems Inc.
2. Grace Construction Products.
3. Hilti, Inc.
4. Johns Manville.
5. Nelson Firestop Products.
6. NUCO Inc.
7. Passive Fire Protection Partners.
8. RectorSeal Corporation.
9. Specified Technologies Inc.
10. 3M Fire Protection Products.
11. Tremco, Inc.; Tremco Fire Protection Systems Group.
12. USG Corporation.

2.2 PENETRATION FIRESTOPPING

A. 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.

B. 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.

1. Fire-resistance-rated walls include fire walls smoke-barrier walls and fire partitions.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. 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.

1. Horizontal assemblies include floors.
2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
3. 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. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

E. 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.

F. 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.

1. Permanent forming/damming/backing materials, including the following:

    a. Slag-wool-fiber or rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
    d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. 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.

G. 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.

H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. 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.

2.4 MIXING

A. 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 and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

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 penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

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 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 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.

3.7 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.

B. Firestopping with No Penetrating

1. UL-Classified Systems: .
2. F-Rating: 1 hour.
3. T-Rating: 1 hour 2 hours Insert number of hours.
4. L-Rating at Ambient and at 400 deg F.
5. W-Rating: No leakage of water at completion of water leakage testing.
6. Type of Fill Materials: As required to achieve rating.

C. Firestopping for Metallic Pipes, Conduit, or Tubing

1. UL-Classified Systems:
2. F-Rating: 1 hour.
3. T-Rating: 1 hour.
4. L-Rating at Ambient and at 400 deg F.
5. W-Rating: No leakage of water at completion of water leakage testing.
6. Type of Fill Materials: As required to achieve rating.

D. Firestopping for Cable Trays with Electric Cables

1. UL-Classified Systems: .
2. F-Rating: 1 hour.
3. T-Rating: 1 hour.
4. L-Rating at Ambient and at 400 deg F.
5. W-Rating: No leakage of water at completion of water leakage testing.
6. Type of Fill Materials: As required to achieve rating.

E. Firestopping for Miscellaneous Electrical Penetrants

1. UL-Classified Systems:
2. F-Rating: 1 hour.
3. T-Rating: 1 hour.
4. L-Rating at Ambient and at 400 deg F.
5. W-Rating: No leakage of water at completion of water leakage testing.
6. Type of Fill Materials: As required to achieve rating.

F. Firestopping for Miscellaneous Mechanical Penetrants

1. UL-Classified Systems:

2. F-Rating: 1 hour.
3. T-Rating: 1 hour.
4. L-Rating at Ambient and at 400 deg F.
5. W-Rating: No leakage of water at completion of water leakage testing.
6. Type of Fill Materials: As required to achieve rating.

END OF SECTION 07841

SECTION 07920 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Polysulfide joint sealants.
4. Latex joint sealants.
5. Acoustical joint sealants.

B. Related Sections:

1. Division 7 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
2. Division 8 Section "Glazing" for glazing sealants.
3. Division 9 Section "Gypsum Board" for sealing perimeter joints.
4. Division 9 Section "Acoustical Tile Ceilings" for sealing edge moldings at perimeters with acoustical sealants.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than six pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.4 ACTION SUBMITTALS

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

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

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

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

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

D. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: two years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 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: 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.

C. Stain-Test-Response Characteristics: 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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation.
b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
c. Pecora Corporation;.
d. Sika Corporation, Construction Products Division; SikaSil-C990.
e. Tremco Incorporated;.

2.3 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Sika Corporation, Construction Products Division; Sikaflex - 15LM.
b. Tremco Incorporated;.

2.4 POLYSULFIDE JOINT SEALANTS

A. Single-Component, Nonsag, Polysulfide Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pacific Polymers International, Inc.; Elastoseal 230 Type I.
b. W. R. Meadows, Inc.; Deck-O-Seal One Step.

B. Multicomponent, Nonsag, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following::

a. BASF Building Systems; Sonolastic Polysulfide Sealant.
b. Pacific Polymers International, Inc.; Elasto-Seal 227 Type II.
c. Pecora Corporation; Synthacalk GC-2+.
d. W. R. Meadows, Inc.; Deck-O-Seal Gun Grade.

2.5 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolac.
b. Bostik, Inc.; Chem-Calk 600.
c. Pecora Corporation; AC-20+.
d. Schnee-Morehead, Inc.; SM 8200.
e. Tremco Incorporated; Tremflex 834.

2.6 ACOUSTICAL JOINT SEALANTS

A. 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.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation;.
b. USG Corporation; SHEETROCK Acoustical Sealant.
c. .

2.7 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that 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. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Remove laitance and form-release agents from concrete.
3. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, 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.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

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

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage

or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07920

SECTION 08110 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Standard hollow metal frames.

B. Related Sections:

1. Division 8 Section "Door Hardware" for door hardware.
2. Division 9 Sections "Interior Painting" for field painting hollow metal doors and frames.
3. Division 16 Sections for electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
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. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
2. For the following items, prepared on Samples about 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:

a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.

E. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 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 10B UL 10C.

1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

D. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Amweld Building Products, LLC.
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Deansteel Manufacturing Company, Inc.
6. Firedoor Corporation.
7. Fleming Door Products Ltd.; an Assa Abloy Group company.
8. Habersham Metal Products Company.
9. Kewanee Corporation (The).
10. Mesker Door Inc.
11. Pioneer Industries, Inc.
12. Security Metal Products Corp.
13. Steelcraft; an Ingersoll-Rand company.
14. Windsor Republic Doors.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 metallic coating.

C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Powder-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.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements in Division 8 Section "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as knocked down unless otherwise indicated.
3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
4. Frames for Wood Doors: 0.067-inch- thick steel sheet.
5. Frames for Borrowed Lights: Same as adjacent door frame.

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, 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 height adjustment. Terminate bottom of frames at finish floor surface.

2.5 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.6 FABRICATION

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

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/NAAMM-HMMA 861.

C. Hollow Metal Frames: 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.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

5. Jamb Anchors: Provide number and spacing of anchors as follows:

   a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

      1) Three anchors per jamb up to 60 inches high.
      2) Four anchors per jamb from 60 to 90 inches high.
      3) Five anchors per jamb from 90 to 96 inches high.
      4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.

   b. Compression Type: Not less than two anchors in each jamb.
   c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."

   1. Locate hardware as indicated, or if not indicated, according to ANSI/NAAMM-HMMA 861.
   2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
   4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 16 Sections.

2.7 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-protection-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 door silencers in frames before grouting.
d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
f. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
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 Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
7. 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.

3.4 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. Remove grout and other bonding material from hollow metal work immediately after installation.

C. 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.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08110

SECTION 08211 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

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

B. Related Sections:
1. Division 8 Section "Glazing" for glass view panels in flush wood doors.
2. Division 9 Sections "Interior Painting" and "Wood Stains and Transparent Finishes" for field finishing doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: For factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.

a. Provide samples for each species of veneer and solid lumber required.
b. Provide samples for each color, texture, and pattern of plastic laminate required.
c. Finish veneer-faced door samples with same materials proposed for factory-finished doors.

3. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

C. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.

D. Fire-Rated Wood Doors: Doors complying with NFPA 80 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 10B UL 10C.

1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, 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.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
   b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Algoma Hardwoods, Inc.
2. Ampco, Inc.
3. Buell Door Company Inc.
4. Chappell Door Co.
5. Eagle Plywood & Door Manufacturing, Inc.
6. Eggers Industries.
7. Graham; an Assa Abloy Group company.
8. Haley Brothers, Inc.
9. Ideal Architectural Doors & Plywood.
10. Ipik Door Company.
11. Lambton Doors.
12. Marlite.
13. Marshfield Door Systems, Inc.
14. Mohawk Flush Doors, Inc.; a Masonite company.
15. Oshkosh Architectural Door Company.
16. Poncraft Door Company.
17. Vancouver Door Company.
18. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

A. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2.
2. Provide doors with either glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

B. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

a. Screw Withdrawal, Face: 700 lbf.
b. Screw Withdrawal, Edge: 400 lbf.

C. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.

1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
2. 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.
3. Pairs: Provide formed-steel edges and astragals with intumescent seals.

a. Finish steel edges and astragals with baked enamel same color as doors.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: Red oak.
3. Cut: Quarter sliced.
4. Match between Veneer Leaves: Slip match.
5. Assembly of Veneer Leaves on Door Faces: Balance match.
6. Pair and Set Match: Provide for doors hung in same opening.
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
8. Exposed Vertical and Top Edges: Same species as faces.
9. Core: Either glued wood stave or structural composite lumber.
10. Construction: Seven plies, either bonded or nonbonded construction.

2.4 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: match existing
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

B. 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, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 8 Section "Glazing."

2.6 SHOP PRIMING

A. Doors for Transparent Finish: Shop prime doors with stain (if required), other required pretreatments, and first coat of finish as specified in Division 9 Section " Interior Painting Wood Stains and Transparent Finishes." Seal all four edges, edges of cutouts, and mortises with first coat of finish.

2.7 FACTORY FINISHING

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

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: AWI conversion varnish system.
3. Staining: Match existing.
4. Effect: match exisitng.
5. Sheen: Satin Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08211

SECTION 08411 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior storefront framing.
2. Interior manual-swing entrance doors and door-frame units.
3. Hardware for manual-swing entrance doors and door-frame units

B. Related Sections:

1. Division 8 Section "Door Hardware" .

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

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

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
d. Noise or vibration created by wind and by thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Sealant failure.
g. Failure of operating units.

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:

D. Deflection of Framing Members:

1. 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. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch whichever is smaller.

1.5 ACTION SUBMITTALS

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

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

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.

F. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of aluminum-framed systems.
2. Include design calculations.

1.6 INFORMATIONAL SUBMITTALS

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

B. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

C. Welding certificates.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

E. Source quality-control reports.

F. Field quality-control reports.

G. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are

indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

F. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

1.9 PROJECT CONDITIONS

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

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration caused by thermal movements.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   d. Adhesive or cohesive sealant failures.
   e. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door

hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings Kawneer 350 medium stile entrance or comparable product by one of the following:

1. Commercial Architectural Products, Inc.
2. EFCO Corporation.
3. TRACO.
4. Tubelite.
5. United States Aluminum.
6. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Nonthermal.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: As indicated.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 8 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual sliding operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: Wide stile; 5-inch nominal width.

   a. Accessible Doors: Smooth surfaced for width of door in area within 10 inchesabove floor or ground plane.

3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

   a. Provide nonremovable glazing stops on outside of door.

B. Entrance Door Hardware: As specified in Division 8 Section "Door Hardware." And balance under this section

2.6 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products and products complying with BHMA standard referenced.
2. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

C. Opening-Force Requirements:

1. Latches and Exit Devices: Not more than 15 lbf required to release latch.

D. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

E. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

F. Operating Trim: BHMA A156.6.

G. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch .

2.7 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physicalisolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Fabricate components for assembly using head-and-sill-receptor system with shear blocks at intermediate horizontal members.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: Dark bronze.
2. Color: As selected by Architect from full range of industry colors and color densities.

2.10 SOURCE QUALITY CONTROL

A. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

E. Install glazing as specified in Division 8 Section "Glazing."

F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

G. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet 1/4 inch over total length.
2. Alignment:

    a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch
    b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch .

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

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

3.6 ENTRANCE DOOR HARDWARE SETS

END OF SECTION 08411

SECTION 08710 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Commercial door hardware for the following:

a. Swinging doors.
b. Fire-rated swinging doors.
c. Other doors to the extent indicated.

2. Cylinders for doors specified in other Sections.

B. Related Sections include the following:

1. Division 08 Section "Hollow Metal Doors and Frames"
2. Division 08 Section "Aluminum-Framed Entrances and Storefronts"
3. Division 08 Section "Flush Wood Doors"

C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1. Thresholds, weather stripping, and cylinders for locks specified in other Sections.

1.3 SUBMITTALS

A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets, if requested.

1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

C. Qualification Data: For Installer.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, latches, and closers as requested.

E. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

F. Warranty: Special warranty specified in this Section.

G. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
2. Content: Include the following information:

a. Identification number, location, hand, fire rating, and material of each door and frame.
b. Type, style, function, size, quantity, and finish of each door hardware item.
c. Complete designations of every item required for each door or opening including name and manufacturer.
d. Fastenings and other pertinent information.
e. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
f. Explanation of abbreviations, symbols, and codes contained in schedule.
g. Mounting locations for door hardware.
h. Door and frame sizes and materials.
i. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

j. List of related door devices specified in other Sections for each door and frame.

3. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

H. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 QUALITY ASSURANCE

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

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
2. Installer shall have warehousing facilities in Project's vicinity.
3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
4. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Fire-Rated 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 and UBC Standard 7-2.

1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.

E. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." In addition to Owner, Construction Manager, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant and Owner's Security Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Requirements for key control system.
4. Address for delivery of keys.

F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to Owner's Representative by registered mail or overnight package service.

1.6 COORDINATION

A. Coordinate layout and installation of recessed hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Coordinate with aluminum entrance door supplier for cylinder installation.

D. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including excessive deflection, cracking, or breakage.
   b. Faulty operation of operators and door hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three (3) years from date of Substantial Completion, except as follows:

a. Exit Devices: Two (2) years from date of Substantial Completion.
b. Manual Closers: Ten (10) years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

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

B. Maintenance Service: Beginning at Substantial Completion, provide six (6) months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Products:

a. Finish: Shall be US10, unless otherwise noted.
b. Manufacture Standard:

1) Butts: Hager, McKinney, Stanley, Ives*
2) Locksets: Sargent and Best* (Owner’s standard)
3) Closers: LCN* (Owner’s standard)
4) Exit Devices: Sargent* (Owner’s standard)
5) Trim: BBW, Rockwood, Hager, Ives*
6) Weatherstrip: Pemko, Hager, National Guard*

B. Substitution requests will be made in accordance with Division 01 requirements.

2.2 SCHEDULED HARDWARE

A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:

1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware

type, the comparable product of one of the other manufacturers that complies with requirements.

2. ANSI/BHMA designations used elsewhere in this Section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.

   a. Butts and Hinges: ANSI A156.1.
   b. Bored and Preassembled Locks and Latches: ANSI/BHMA A156.2.
   c. Exit Devices: ANSI A156.3.
   d. Door Controls - Closers: ANSI A156.4. 180 degree swing only!
   e. Auxiliary Locks and Associated Products: ANSI/BHMA A156.5.
   f. Architectural Door Trim: ANSI A156.6.
   g. Template Hinge Dimensions: ANSI A156.7.
   h. Door Controls - Overhead Holders: ANSI A156.8.
   i. Mortise Locks and Latches: ANSI A156.13.
   j. Closer Holder Release Devices: ANSI A156.15.
   k. Auxiliary Hardware: ANSI A156.16.
   l. Self-Closing Hinges and Pivots: ANSI A156.17.
   m. Materials and Finishes: ANSI A156.18.

2.3 MATERIALS AND FABRICATION

A. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

B. 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.

C. 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.

D. 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. 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. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.4 HINGES, GENERAL

A. Quantity: Provide the following, unless otherwise indicated:

1. Two Hinges: For doors with heights up to 60 inches.
2. Three Hinges: For doors with heights 61 to 90 inches.

B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

C. Hinge Weight: As indicated in hardware sets.

D. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel with stainless-steel pin.
2. Interior Hinges: Steel with steel pin.
3. Hinges for Fire-Rated Assemblies: Steel with steel pin.

E. Hinge Options: Where indicated in door hardware sets or on Drawings:

1. Safety Stud: Designed for stud in one leaf to engage hole in opposing leaf.
2. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging doors.
3. Corners: Square.

F. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.

2.5 LOCKS, LATCHES, AND BOLTS

A. Strikes: 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.

B. Lock Throw: Provide 5/8-inch (16-mm) minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

C. Flush Bolt Heads: Minimum of 1/2-inch- (13-mm-) diameter rods of brass, bronze, or stainless steel with minimum 12-inch- (300-mm-) long rod for doors up to 84 inches (2100 mm) in height. Provide longer rods as necessary for doors exceeding 84 inches (2100 mm) in height.

D. Cylindrical Locks - ANSI A156.2 Series 4000, Grade 1 Strength and Operational requirements. Meets A117.1 Accessibility Codes. Latch bolts shall be steel with minimum ½” throw, deadlocking on keyed and exterior functions. ¾” throw anti-friction latchbolt on pairs of fire doors. Lock case shall be steel. Provide 5/8" minimum throw of latch and deadbolt used on pairs of doors.

2.6 KEYING REQUIREMENTS

A. General: Supplier will meet with Owner to finalize keying requirements and obtain final instructions in writing.

B. Review the keying system with the Owner and provide the type required, master, grandmaster or great-grandmaster, integrated with Owner's existing system. If key pinning charts are required, owner to furnish charts to hardware supplier.

C. Furnish temporary keyed cores for the construction period, and remove these when directed. The construction cores remain property of the supplier and shall be returned to the supplier when they are removed. Contractor shall install the permanent cores in the presence of the owner's representative.

D. Permanent Keys: Secured shipment direct from point of origination to Owner's Representative

1. For estimate: 2 keys per change combination, 5 master keys per group, 5 grand-master keys, 3 control keys.

2.7 PUSH/PULL UNITS

A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation, thru-bolted.

2.8 CLOSERS

A. Accessibility Requirements: Where handles, pulls, latches, locks and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural Transportations Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Comply with the following maximum opening-force requirements:

a. Interior, Non-fire-rated Hinged Doors: 5 lbf applied perpendicular to door.
b. Fire Doors: Minimum opening force allowable by Authorities Having Jurisdiction (AHJ).

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15lbf to open door to minimum required width.

C. Cylinder: Shall be of high strength cast iron construction. All door exterior closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified independent testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles for all exterior door closers must be provided. Cylinder shall have been manufactured and in the marketplace for a minimum of 10 years

D. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and

anticipated frequency of use. Provide factory sized closers, adjustable to meet field conditions and requirements for opening force.

E. Surface Closers: BHMA A156.4 Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
4. Thru-bolts at wood doors unless doors are provided with closer blocking. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Opening pressure: Exterior doors 8.5 lb., interior doors 5 lb., labeled fire doors 15 lb.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior doors do not require seasonal adjustments in temperatures from 120 degrees F to -30 degrees F, furnish data on request.
10. Non-flaming fluid will not fuel door or floor covering fires.
11. Pressure relief values are not allowed.

2.9 EXIT DEVICES/PANIC HARDWARE

A. General features: BHMA A156.3, Grade 1.

B. Accessibility Requirements: Where handles, pulls, latches, locks and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural Transportations Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15lbf to release the latch. Locks shall not require use of a key, tool of special knowledge for operation.

D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to AHJ for panic protection, based on testing according to UL 305.

1. Push-through touch pad design. No exposed touch bar fasteners, no exposed cavities when operated.
2. No exposed screws to show through glass doors.
3. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.

E. Specific features:

1. Lever Trim: Vandal resistant, forged brass or bronze, match lockset lever design.
2. Fire-Labeled Devices: UL label indicating “Fire Exit Hardware”.
3. Furnish all exit devices with deadlocking latchbolts.
4. End caps shall be sloped and of heavy-duty metal alloy construction. When device end cap is installed, no raised edges will protrude. Plastic or metal stamping will not be acceptable.
5. Provide all shim kits and filler plates to allow flush mounting of exit devices on all types of doors used in this project.

2.10 TRIM AND STOPS

A. Kick plates, mop plates, and armor plates, shall be .050 gauge with 612 finish. Kick plates to be 10” high, mop plates to be 5” high. All plates shall be two (2) inches less full width of door.

B. Push plates, pull plates, door pulls, and miscellaneous door trim shall be shown in the hardware schedule.

C. Doorstops shall be furnished for all doors to prevent damage to doors or hardware from striking adjacent walls or fixtures. Wall stops are preferred. Floor stops are used only where noted in hardware schedule. Where conditions prohibit the use wall type stops, furnish overhead stops either surface mounted or concealed as noted in hardware sets.

2.11 WEATHERSTRIPPING AND SEALS

A. General: Provide continuous weather stripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.12 THRESHOLDS

A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.

2.13 HARDWARE FINISHES

A. Match items to the manufacturer's standard color and texture finish for the latch and locksets (or push-pull units if no latch or lock sets).

B. Provide finishes that match those established by BHMA or, if none established, match the Architect's sample.

C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

D. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.2 PREPARATION

A. Steel Doors and Frames: Comply with DHI A115 Series.

1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated, as follows, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.7 DOOR HARDWARE SETS

HW SET: 01
DOOR NUMBER: (Includes but is not limited to the following doors)
101D 101E 127A

EACH TO HAVE:

1	EA	CYLINDER	CYLINDER AS REQ'D BY DOOR MFG	613	SAR
1			REMAINING HARDWARE BY DOOR MFG		B/O

HW SET: 02
DOOR NUMBER: (Includes but is not limited to the following doors)
125C 126A

EACH TO HAVE:

4	EA	HINGE	5BB1 4.5 X 4.5 NRP	639	IVE
1	EA	STOREROOM LOCK	93K7D 15D S3 (ANSI STRIKE)	612	BES
1	EA	SURFACE CLOSER	4041 RW/PA (INSTALL ON NON-PUBLIC SIDE)	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	612	IVE
1	EA	WALL STOP	WS401CCV	612	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 03
DOOR NUMBER: (Includes but is not limited to the following doors)
125A 125B

EACH TO HAVE:

2	EA	HINGE	5BB1 4.5 X 4.5 NRP	639	IVE
1	EA	ELEC HINGE	TEF2+4	612	MAR
1	EA	EXIT DEVICE	12-19-43-56-GL-8813 X TB	612	SAR
1	EA	RIM CYLINDER	34	612	SAR
1	EA	SURFACE CLOSER	4041 EDA X 18PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	612	IVE
1	EA	WALL STOP	WS401CCV	612	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	1 AMP POWER SUPPLY	3520		SAR
1	EA	SMART CARD READER	SXF1100	BLK	SCE

ALL ELECTRIFIED HARDWARE TO BE INSTALLED IN PLACE FOR FUTURE USE WHEN ACCESS CONTROL IS ADDED TO THE BUILDING.

HW SET: 04
DOOR NUMBER: (Includes but is not limited to the following doors)
257B

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	639	IVE
1	EA	CLASSROOM LOCK	10-28-10G37 LL	612	SAR
1	EA	SURFACE CLOSER	4041 EDA X 18PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	612	IVE
1	EA	WALL STOP	WS401CCV	612	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 05

DOOR NUMBER: (Includes but is not limited to the following doors)
257A

EACH TO HAVE:

6	EA	HINGE	5BB1 4.5 X 4.5 NRP	639	IVE
1	SET	AUTO FLUSH BOLT	FB42	612	IVE
1	EA	CLASSROOM LOCK	10-28-10G37 LL	612	SAR
1	EA	COORDINATOR	COR X FL X BRACKETS AS REQ'D		IVE
1	SET	ASTRAGAL	9605A 84"	DKB	NGP
2	EA	SURFACE CLOSER	4041 EDA X 18PA	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW	612	IVE
2	EA	WALL STOP	WS401CCV	612	IVE
1	SET	SEALS	2525B	BRN	NGP

SECTION 08800 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Doors.
2. Storefront framing.
3. Glazed entrances.
4. Interior borrowed lites.

B. Related Sections:

1. Division 8 Section Aluminum framed Entrances and storefronts

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glazing Accessory Samples: For gaskets, in 12-inch lengths.

C. 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.(for glass elements more than 8’ high)

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Preconstruction adhesion and compatibility test report.

D. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

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.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.

C. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. No preference.

2. Glass: Clear float.
3. Ceramic Coating Color: Match architects sample

D. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.4 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 790.
b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
c. May National Associates, Inc.; Bondaflex Sil 290.

d. Pecora Corporation; 890.
e. Sika Corporation, Construction Products Division; SikaSil-C990.
f. Tremco Incorporated; Spectrem 1.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 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. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

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. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. 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.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 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.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 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. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. 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.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. 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.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 08800

SECTION 09111 - NON-LOAD-BEARING STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATION SUBMITTALS

A. Evaluation Reports: For firestop tracks, from ICC-ES.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Fire-Test-Response Characteristics: 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.

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

2.2 FRAMING SYSTEMS

A. Framing Members, 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: ASTM A 653/A 653M, G60, hot-dip galvanized, unless otherwise indicated.

B. Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.027 inch.
b. Depth: As indicated on Drawings.

2. Dimpled Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.025 inch.
b. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
2) MBA Building Supplies; Slotted Deflecto Track.
3) Steel Network Inc. (The); VertiTrack VTD Series.
4) Superior Metal Trim; Superior Flex Track System (SFT).
5) Telling Industries;.

D. Firestop Tracks: 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 not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire Trak Corp.; Fire Trak System.
b. Grace Construction Products; FlameSafe FlowTrak System.
c. Metal-Lite, Inc.; The System.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.027 inch.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.018 inch.
2. Depth: As indicated on Drawings.

G. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

H. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Hanger Attachments to Concrete:

1. 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.

a. Type: Postinstalled, expansion anchor.

2. 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.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645.

    a. Minimum Base-Metal Thickness: 0.027 inch.
    b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

    a. Minimum Base-Metal Thickness: 0.018 inch.

4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.

    a. Configuration: Asymmetrical or hat shaped.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    b. Chicago Metallic Corporation; Drywall Grid System.
    c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

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 of the Work.

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

3.2 PREPARATION

A. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install studs so flanges within framing system point in same direction.

1. Space studs as follows:

a. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
b. Multilayer Application: 16 inches o.c. unless otherwise indicated.

B. 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. 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. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

C. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

D. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

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 required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09111

SECTION 09250 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Division 9 Section "Non-Load-Bearing Steel Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.

2. Apply or install final finish indicated, including painting on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

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

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, 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.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

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

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

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

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.

5. National Gypsum Company.
6. PABCO Gypsum.
7. Temple-Inland.
8. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

E. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 1.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. L-Bead: L-shaped; exposed long flange receives joint compound.
d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
e. Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

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

a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

   a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. 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.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
b. Grabber Construction Products; Acoustical Sealant GSC.
c. Pecora Corporation;.
d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
e. USG Corporation; SHEETROCK Acoustical Sealant.

2. Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish with flame-spread and smoke-developed indexes of not more than 25 when tested according to ASTM E 84.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Georgia-Pacific Gypsum LLC; ToughRock Ceiling Textures/Polystyrene.
b. National Gypsum Company; ProForm Perfect Spray.
c. USG Corporation; SHEETROCK Ceiling Spray Texture, QT.

2. Texture: [**Fine**] [**Medium**] [**Coarse**].

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

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. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: As indicated on Drawings.
2. Ceiling Type: As indicated on Drawings.
3. Abuse-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. Athigh walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
2. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLING TRIM ACCESSORIES

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

B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. U-Bead: Use at exposed panel edges.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Where indicated on Drawings.
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 other Division 9 Sections.

5. Level 5: Where indicated on Drawings.

    a. Primer and its application to surfaces are specified in other Division 9 Sections.

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

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

END OF SECTION 09250

SECTION 09512 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Acoustical tiles for ceilings.
2. Concealed suspension systems.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6-inches- in size.

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Tile: Set of full-size Samples of each type, color, pattern, and texture.
2. Concealed Suspension-System Members: 6-inch- long Sample of each type.
3. Exposed Moldings and Trim: Set of 6-inch- long Samples of each type and color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each acoustical tile ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Evaluation Reports: For each acoustical tile ceiling suspension system and anchor and fastener type, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

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

1.6 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. Acoustical Ceiling Units: Full-size tiles equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to the National Voluntary Laboratory Accreditation Program (NVLAP) for testing indicated.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical ceiling area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

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

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 50 or less.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL TILES, GENERAL

A. Low-Emitting Materials: Acoustical tile ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Source Limitations:

1. Acoustical Ceiling Tile: Obtain each type from single source from single manufacturer.
2. Suspension System: Obtain each type from single source from single manufacturer.

C. Source Limitations: Obtain each type of acoustical ceiling tile and supporting suspension system from single source from single manufacturer.

D. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

E. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.

2.3 ACOUSTICAL TILES

A. Basis-of-Design Product: Subject to compliance with requirements, provide USG “Radar” Clima Plus High-CAC Panel, 2 x 2, tegular edge

1. match existing in adjacent spaces for surface appearance .

B. Classification: Provide tiles complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; match existing
2. Pattern: match existing.

C. Color: White.

D. Edge/Joint Detail: tegular edge.

E. Thickness: 3/4 inch.

F. Modular Size: 24 by 24 inches.

G. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical tiles 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.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: 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. Type: Postinstalled expansion anchors.
   b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 for Class SC 1 service condition.

2. 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 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.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

D. Hanger Rods Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.

G. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical tiles in-place.

2.5 METAL SUSPENSION SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide USG DXF Fineline, 9/16 face or comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G30 coating designation.

1. Structural Classification: Heavy-duty system.
2. Access: Upward and end pivoted or side pivoted, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.

   a. Initial Access Opening: In each module, 24 by 24 inches.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. Fry Reglet Corporation.
5. Gordon, Inc.
6. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic

design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical tile edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Extruded-Aluminum Edge Moldings and Trim: 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 and complying with seismic design requirements and the following:

1. 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 for Alloy and Temper 6063-T5.
2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.7 ACOUSTICAL SEALANT

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

1. Acoustical Sealant for Exposed and Concealed Joints:

   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. USG Corporation; SHEETROCK Acoustical Sealant.

2. Acoustical Sealant for Concealed Joints:

   a. Henkel Corporation; OSI Sealants Pro-Series SC-175 Rubber Base Sound Sealant.
   b. Pecora Corporation; AIS-919.
   c. Tremco, Inc.; Tremco Acoustical Sealant.

B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. General: 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."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
3. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
4. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
5. Do not attach hangers to steel deck tabs.

6. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
7. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical tiles.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Arrange directionally patterned acoustical tiles as follows:

1. Install tiles in a basket-weave pattern.

F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.

1. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.
2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tile and moldings, spaced 12 inches o.c.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Compliance of seismic design.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Perform the following tests and inspections of completed installations of acoustical tile ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion but no tiles have been installed. Do not proceed with installations of acoustical tile ceiling hangers for the next area until test results for previously completed installations of acoustical tile ceiling hangers show compliance with requirements.

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 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 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.

D. Acoustical tile ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 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.

END OF SECTION 09512

SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

1.2 ACTION SUBMITTALS

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

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

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:

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

    a. Allstate Rubber Corp.; Stoler Industries.
    b. Armstrong World Industries, Inc.
    c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
    d. Endura Rubber Flooring; Division of Burke Industries, Inc.
    e. Flexco, Inc.
    f. Johnsonite.
    g. Mondo Rubber International, Inc.
    h. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
    i. PRF USA, Inc.
    j. Roppe Corporation, USA.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: coved

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Job formed.

H. Finish: As selected by Architect from manufacturer's full range.

I. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

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

    a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
    b. Flexco, Inc.
    c. Johnsonite.
    d. R.C.A. Rubber Company (The).
    e. Roppe Corporation, USA.

B. Description: Reducer strip for resilient floor covering Joiner for tile and carpet.

C. Material: Rubber.

D. Profile and Dimensions: As indicated.

E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

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 resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 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 and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 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 practicable 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.

3.3 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 carpet that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Coordinate with owners maintenance department

C. Cover resilient products until Substantial Completion.

END OF SECTION 09653

SECTION 09681 - CARPET TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes modular, tufted carpet tile.

B. Related Requirements:

1. Division 1 Section "Selective Demolition" for removing existing floor coverings.
2. Division 9 Section " Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet tile.
3. Division 9 Section "Carpet."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include installation recommendations for each type of substrate.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.

5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. 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.

C. Mockups: for logo: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.10 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, loss of tuft bind strength, loss of face fiber, and delamination.
3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE CP-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. Interface floor.

B. Color: Mint 5424.

C. Pattern: Panorama

D. Fiber Content: 100 percent nylon 6, 6.

E. Fiber Type: Antron Lumena.

F. Pile Characteristic: textured loop pile.

G. Density: 5445.

H. Pile Thickness: .119 for finished carpet tile according to ASTM D 6859.

I. Stitches: 8.5 per inch.

J. Surface Pile Weight: 18 oz./sq. yd. .

K. Total Weight: 18 oz./sq. yd for finished carpet tile.

L. Primary Backing/Backcoating: Manufacturer's standard composite materials.

M. Secondary Backing: Manufacturer's standard material.

N. Backing System: Glas Bac tile.

O. Size: 19.69” x 19.69”..

P. Applied Soil-Resistance Treatment: Manufacturer's standard material.

Q. Antimicrobial Treatment: Manufacturer's standard material.

R. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
4. Tuft Bind: Not less than 6.2 lbf according to ASTM D 1335.
5. Delamination: Not less than 4 lbf/in. according to ASTM D 3936.
6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
8. Resistance to Insects: Comply with AATCC 24.
9. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
10. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
11. Antimicrobial Activity: 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.
12. Electrostatic Propensity: Less than 2 kV according to AATCC 134.

2.2 CARPET TILE CP-2

A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. Interface floor.

B. Color: Mint 5424.

C. Pattern: Urban Grid

D. Everything else to be the same as CP-1

2.3 CARPET TILE CP-3 (logo)

A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. Interface floor.

B. Color: Midnight 4945

C. Pattern: Menagerie 13805

D. Fiber Content: 100 percent nylon 6.

E. Fiber Type: Nylon.

F. Pile Characteristic: tufted tip sheared.

G. Density: 6832.

H. Pile Thickness: .18 for finished carpet tile according to ASTM D 6859.

I. Stitches: 10 per inch.

J. Gage: 1/12

K. Surface Pile Weight: 26 oz./sq. yd. .

L. Primary Backing/Backcoating: Manufacturer's standard composite materials.

M. Secondary Backing: Manufacturer's standard material.

N. Backing System: Glas Bac tile.

O. Size: 19.69” x 19.69”..

P. Applied Soil-Resistance Treatment: Protekt.

Q. Antimicrobial Treatment: Intersept.

R. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
4. Tuft Bind: Not less than 6.2 lbf according to ASTM D 1335.
5. Delamination: Not less than 4 lbf/in. according to ASTM D 3936.
6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
8. Resistance to Insects: Comply with AATCC 24.
9. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
10. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
11. Antimicrobial Activity: 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.
12. Electrostatic Propensity: Less than 3 kV according to AATCC 134.

2.4 CARPET TILE CP-4

A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. Interface floor.

B. Color: Olive 7191

C. Pattern: Entry Level 12901

D. Fiber Content: 100 percent nylon 6, 6.

E. Fiber Type: Nylon.

F. Pile Characteristic: textured loop.

G. Density: 6720.

H. Pile Thickness: .15 for finished carpet tile according to ASTM D 6859.

I. Stitches: 10 per inch.

J. Gage: 1/12

K. Surface Pile Weight: 28 oz./sq. yd. .

L. Primary Backing/Backcoating: Manufacturer's standard composite materials.

M. Secondary Backing: Manufacturer's standard material.

N. Backing System: Glas Bac tile.

O. Size: 19.69” x 19.69”..

P. Applied Soil-Resistance Treatment: Protekt w/ Zony.

Q. Antimicrobial Treatment: Intercept.

R. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
4. Tuft Bind: Not less than 6.2 lbf according to ASTM D 1335.
5. Delamination: Not less than 4 lbf/in. according to ASTM D 3936.
6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
8. Resistance to Insects: Comply with AATCC 24.
9. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
10. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
11. Antimicrobial Activity: 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.
12. Electrostatic Propensity: Less than 3 kV according to AATCC 134.

2.5 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

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. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

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

3.2 PREPARATION

A. General: 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.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. 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.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. 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.

G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. 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.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09681

SECTION 09852 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes shop-fabricated, fabric-wrapped panel units tested for acoustical performance, including:

1. Sound-absorbing wall panels.

1.3 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

B. SAA: Sound Absorption Average.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of fabric facing, panel edge, core material, and mounting indicated.

B. Shop Drawings: For sound-absorbing wall units. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge and core materials.

1. Include elevations showing panel sizes and direction of fabric weave and pattern matching.

C. Samples for Initial Selection: For each type of fabric facing from sound-absorbing wall unit manufacturer's full range.

D. Samples for Verification: For the following products, prepared on Samples of size indicated below:

1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
2. Panel Edge: 12-inch- long Sample(s) showing each edge profile, corner, and finish.
3. Core Material: 12-inch- square Sample at corner.
4. Mounting Devices: Full-size Samples.

5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Electrical outlets, switches, and thermostats.
2. Items penetrating or covered by sound-absorbing wall units including the following:

   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Alarms.
   e. Sprinklers.
   f. Access panels.

3. Show operation of hinged and sliding components covered by or adjacent to sound-absorbing wall units.

B. Product Certificates: For each type of sound-absorbing wall unit, from manufacturer.

C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sound-absorbing wall units to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 yards.
2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices, including unopened adhesives.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain sound-absorbing wall units from single source from single manufacturer.

B. Fire-Test-Response Characteristics: Provide sound-absorbing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrication, and installation.

1. Build mockup of typical wall area as directed by Architect. Include intersection of wall and ceiling, corners, and perimeters.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

D. Preinstallation Conference: Conduct conference at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and sound-absorbing wall unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.10 PROJECT CONDITIONS

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

B. Lighting: Do not install sound-absorbing wall units until a permanent level of lighting is provided on surfaces to receive the units.

C. Air-Quality Limitations: Protect sound-absorbing wall units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify locations of sound-absorbing wall units and actual dimensions of openings and penetrations by field measurements before fabrication.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-absorbing wall units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:

a. Acoustical performance.
b. Fabric sagging, distorting, or releasing from panel edge.
c. Warping of core.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOUND-ABSORBING WALL UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:

1. Whisper Walls.

B. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material.

1. Basis-of-Design Product: Whisper walls.
2. Mounting: Edge mounted with splines secured to substrate.

a. Finish Color at Exposed Edges: Match color of facing material and as selected by Architect from manufacturer's full range.

3. Mounting: Back mounted with manufacturer's standard metal clips or bar hangers, secured to substrate.
4. Core: Manufacturer's standard.

a. Core-Face Layer: Manufacturer's standard.

5. Edge Construction: Manufacturer's standard.
6. Edge Profile: Square.
7. Corner Detail in Elevation: Square with continuous edge profile indicated.
8. Reveals between Panels: Flush reveals.
9. Facing Material: As indicated on Drawings.
10. Acoustical Performance: Sound absorption NRC of not less than 0.65 according to ASTM C 423 for Type A mounting according to ASTM E 795.
11. Nominal Overall Panel Thickness: 1 inch.
12. Panel Width: As indicated on Drawings.
13. Panel Height: As indicated on Drawings.

2.2 MATERIALS

A. General:

B. Core Materials: Manufacturer's standard.

C. Facing Material: Fabric from same dye lot; color and pattern matching Architect's samples.

1. Manufacturer: Maharam.
2. Product Line/Pattern: Parallel.
3. Pattern Repeat: 0.
4. Style Number: 901180.
5. Color: 003.
6. Fiber Content: 52 percent post industrial recycled polyester 48 % post consumer recycled polyester.
7. Width: 66 inches.

D. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:

1. Splines: Manufacturer's standard concealed metal or plastic splines that engage the kerfed edges of the unit, with other moldings and trim for interior corners, exterior corners, and exposed edges, with factory-applied finish on exposed items.
2. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.

2.3 FABRICATION

A. General: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

1. Glass-Fiber Board and Mineral-Fiber Board Cores: Chemically harden core edges and areas of core where mounting devices are attached.

B. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.

1. Square Corners: Tailor corners. Heat seal vinyl fabric seams at corners.
2. Nonsquare Corners: Attach facing material so there are no seams or gathering of material.
3. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.

C. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.

3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, fabricated units, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing wall units.

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

3.2 INSTALLATION

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

B. Comply with sound-absorbing wall unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

C. Align and level fabric pattern and grain among adjacent units.

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb and Level: Plus or minus 1/16 inch.

B. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

3.4 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 09852

SECTION 09912 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.
   1. Steel.
   2. Wood.
   3. Gypsum board.

B. Related Requirements:

   1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
   2. Division 6 Sections for shop priming carpentry with primers specified in this Section.

1.3 DEFINITIONS

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

B. Gloss Level 2: 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: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 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: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Columbia Paint & Coatings.

B. Products: Subject to compliance with requirements, provide product listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Colors: Match Architect's samples.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior:

2.4 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior:

   1. Columbia Paint and Coatings
      a. Color to match Benjamin Moore “November Rain” 2142-60 (walls)

b. Color to Match Benjamin Moore “Timothy Straw” 2149040 (accent color)
c. Color to match Benjamin Moore “Chalk White” 2126-70 (ceilings).

B. Primer, Latex, for Interior Wood

1. Columbia Paint and Coatings
a. . Color to match Benjamin Moore “November Rain” 2142-60

2.5 METAL PRIMERS

A. Primer, Rust-Inhibitive, Water Based:

1. Columbia Paint and Coatings.

2.6 WATER-BASED PAINTS

A. Latex, Interior, (Gloss Level 2, eggshell):

1. Columbia Paint and Coatings

B. Latex, Interior, (Gloss Level 4, semi gloss):

1. Columbia Paint and Coatings
a. Color to match Benjamin Moore “November Rain” 2142-60

.

2.7 DRY FOG/FALL COATINGS

A. Dry Fall, Latex, Flat:

1. Columbia Paint and Coatings
a. Black, in exposed ceiling areas where indicated.

B. Dry Fall, Water Based, for Galvanized Steel, Flat (Gloss Level 1):

1. Columbia Paint and Coatings
a. Black, in exposed ceiling areas where indicated

2.8 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

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

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 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.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:]

1. SSPC-SP 2, "Hand Tool Cleaning."

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. 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.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. 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.

D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in occupied spaces:
   a. Uninsulated metal piping.
   b. Pipe hangers and supports.
   c. Metal conduit.
   d. Other items as directed by Architect.

2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. 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.

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

END OF SECTION 09912

SECTION 10101 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Markerboards.

1.3 DEFINITIONS

A. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.

B. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.4 ACTION SUBMITTALS

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

1. Include individual panel weights for sliding visual display units.
2. Environmental Chambers."

B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of panel joints.
2. Include sections of typical trim members.

C. Samples for Initial Selection: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:

1. Actual sections of high-pressure-laminate visual display surface display rail.
2. Include accessory Samples to verify color selected.

D. Samples for Verification: For each type of visual display surface indicated.

1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: 6-inch- long sections of each trim profile.
3. Accessories: Full-size Sample of each type of accessory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.

B. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display surfaces vertically with packing materials between each unit.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is

complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.10 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Surfaces lose original writing and erasing qualities.
b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. If needed, insert performance requirements for gloss, surface distortion, light reflectance, impact

B. High-Pressure Plastic Laminate: NEMA LD 3.

C. Extruded Aluminum: ASTM B 221, Alloy 6063.

D. Adhesives: Manufacturer's standard product that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 MARKERBOARD ASSEMBLIES

A. High-Pressure-Laminate Markerboard Assembly: Balanced, high-pressure, factory-laminated chalkboard assembly of three-ply construction consisting of backing sheet, fiberboard core material, and high-pressure-laminate writing surface.

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

a. Best-Rite Manufacturing.
b. EverProducts by Glenroy Inc.
c. Marsh Industries, Inc.; Visual Products Group.

B. covering manufacturer for intended substrate.

2.3 MARKERBOARD ACCESSORIES

A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; slim size and standard shape.

1. Factory-Applied Trim: Manufacturer's standard.

B. Chalktray: Manufacturer's standard, continuous.

1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

2.4 FABRICATION

A. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

B. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

1. 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.
2. Provide manufacturer's standard vertical-joint system between abutting sections of markerboards.
3. Provide manufacturer's standard mullion trim at joints between markerboards of combination units.
4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

C. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.5 GENERAL FINISH REQUIREMENTS

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

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

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

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.7 VISUAL DISPLAY SURFACE SCHEDULE

A. Visual Display Board: Factory assembled.

1. Markerboard: High-pressure-laminate markerboard assembly.

    a. Color: White.

2. Corners: Square.
3. Width: As indicated on Drawings Insert dimension.
4. Height: As indicated on Drawings Insert dimension.
5. Mounting: Wall.
6. Mounting Height: As indicated on Drawings.
7. Factory-Applied Aluminum Trim: Manufacturer's standard with clear anodic finish.
8. Accessories:

    a. Chalktray: Solid type.
    b. Map rail with display rail map hooks and clips.
    c. Easel pad clamps.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine walls and partitions for proper preparation and backing for visual display surfaces.

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

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.

1. Prepare surfaces to receive visual display wall coverings and test for moisture according to requirements specified in Division 9 Section "Wall Coverings."

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings,. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

3.5 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 10101

SECTION 10522 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:

a. Portable fire extinguishers.

B. Related Sections:

1. Division 9 painting Sections for field painting fire protection cabinets.

1.3 ACTION SUBMITTALS

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

1. 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. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches square.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. 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.

1.6 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated. (new and existing)

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.7 SEQUENCING

A. Apply decals on field-painted, fire protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 MATERIALS

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

B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

C. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.2 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fire End & Croker Corporation;.
    b. J. L. Industries, Inc., a division of Activar Construction Products Group;.
    c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc;.
    d. Larsen's Manufacturing Company;.
    e. Modern Metal Products, Division of Technico Inc.;.
    f. Moon-American;.
    g. Potter Roemer LLC;.
    h. Watrous Division, American Specialties, Inc.;.

B. Cabinet Construction: 1-hour fire rated.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Semirecessed Cabinet: 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). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
2. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Steel sheet Same material and finish as door.

F. Door Material: Steel sheet.

G. Door Style: Fully glazed panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch.
2. Provide manufacturer's standard hinge permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: 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: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
3. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
4. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
5. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate to match existing.

   a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

      1) Location: Applied to location similar to exsiting.
      2) Application Process: Decals.
      3) Lettering Color: match existing.

4) Orientation: match existing.

6. Alarm: Manufacturer's standard alarm that actuates when fire protection cabinet door is opened and that is powered by batteries.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:

a. Exterior of cabinet, door, and trim except for those surfaces indicated to receive another finish.
b. Interior of cabinet and door.

2. Steel: Baked enamel or powder coat.

2.3 FABRICATION

A. Fire Protection Cabinets: 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.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

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

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. 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.

2.5 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling".

B. Factory Prime Finish: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Color and Gloss: Match existing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

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

3.2 PREPARATION

A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
4. Fire-Rated, Hose and Valve Hose-Valve Cabinets:

a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
b. Seal through penetrations with firestopping sealant as specified in Division 7 Section "Through-Penetration Firestop Systems."

C. Identification: Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. 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 10522

SECTION 10523 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

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 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.

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

   a. Amerex Corporation.
   b. Ansul Incorporated; Tyco International Ltd.
   c. Badger Fire Protection; a Kidde company.
   d. Buckeye Fire Equipment Company.
   e. Fire End & Croker Corporation.
   f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
   g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
   h. Larsen's Manufacturing Company.
   i. Moon-American.
   j. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
   k. Potter Roemer LLC.
   l. Pyro-Chem; Tyco Safety Products.

2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type: UL-rated 10 lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10523

SECTION 12610 - FIXED LECTURE HALL TABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes fixed audience seating with the following:

1. Standard floor mounting.
2. Power and data service to individual seats.

B. Related Sections:

1. Division 16 Sections for electrical service and connections to seating junction box locations for aisle lighting fixtures and power receptacles.
2. Division 16 Sections for voice and data communication service and connections to seating junction box locations for data ports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fixed audience seating. Include electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Layout: Show tablelayout, aisle widths, row-lettering scheme, and chair spacing in each row.
2. Accessories: Show accessories, including locations of electrical devices, accessibility provisions, and attachments to other work.
3. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For each type of exposed finish, color, texture, and pattern indicated.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Plastic Laminate: Manufacturer's standard-size unit, not less than 3 inches square.
2. Baked-on Coating Finishes: Manufacturer's standard-size unit, not less than 3 inches square.
3. Aluminum Finishes: Manufacturer's standard-size unit, not less than 3 inches square.

4. Wood and Plywood Materials and Finishes: Manufacturer's standard-size unit, not less than 3 inches square.
5. Row-Letter and Chair-Number Plates: Full-size units with letters and numbers marked.
6. Aisle Lighting: Full-size unit.
7. Power and Data Service Devices: Full-size units.
8. Exposed Fasteners: Full-size units of each type.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fixed tables to include in maintenance manuals. Include the following:

1. Precautions for cleaning materials and methods that could be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Receptacles: Furnish a quantity of full-size units equal to 5 percent of amount installed.
2. Data Ports: Furnish a quantity of full-size units equal to 5 percent of amount installed.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of table required, including accessories and mounting components, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups for the following types of fixed tables including finishes, and accessories:

a. Size: typical two-seat unit.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of seating layout and construction contiguous with tables by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate layout and installation of electrical wiring and devices with table layout to ensure that floor junction boxes for electrical devices are accurately located to allow connection without exposed conduit.

1. Coordinate wiring and power receptacles installed in seating with requirements in Division 16 Sections.
2. Coordinate wiring and data ports installed in seating with requirements in Division 16 Sections.

B. Coordinate layout and installation of diffuser pedestals with HVAC work and with properties of diffuser pedestals to ensure alignment, proper air diffusion, and correct seat locations.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fixed audience seating that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including standards, beams, and pedestals.
b. Faulty operation of electrical components.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: As follows, from date of Substantial Completion.

a. Structural: 10 years.
b. Electrical Components: three years.
c. Plastic, Wood, and Paint Components: Five years.

PART 2 - PRODUCTS

2.1 MATERIALS AND FINISHES

A. Steel: ASTM A 36/A 36M plates, shapes, and bars; ASTM A 513 mechanical tubing; ASTM A 1008/A 1008M cold-rolled sheet; and ASTM A 1011 hot-rolled sheet and strip.

B. Cast Iron: ASTM A 48/A 48M, Class 25, gray iron castings free of blow holes and hot checks with parting lines ground smooth.

C. Metal Finish: Finish exposed metal parts with manufacturer's standard minimum 1.5-mil- thick, epoxy baked-on powder coating.

1. Color: As selected by Architect from manufacturer's full range.

D. Medium-Density Fiberboard: ANSI A208.2, Grade MD.

E. Concealed Plywood: HPVA HP-1 hardwood plywood or DOC PS 1 softwood plywood, as standard with manufacturer.

F. Exposed Plywood: HPVA HP-1, Face Grade A, hardwood veneer core with color-matched hardwood-veneer faces.

G. Plastic Laminate: NEMA LD 3, Grade VGS for vertical surfaces and Grade HGS for horizontal surfaces.

1. Color and Pattern: As selected by Architect from manufacturer's full range.

2.2 FIXED LECTURE HALL TABLES

A. Fixed Lecture Hall tables: Interior assembly-space in permanent arrangement as shown on Drawings.

1. Basis-of-Design Product: Subject to compliance with requirements, provide KI Seminar tables -62105 or comparable product by one of the following:

a. American Seating Company.
b. Irwin Seating Company.
c. KI, Inc.

B. Table Mounting Standards: Floor or Riser attached of the following material:

1. Steel: One-piece heavy-tube or reinforced sheet with welded mounting plate and welded connections for seat pivots, backs, armrests, and end panels.

C. End Panels:

1. Material: Plastic laminate.

D. Height: Standard-.

E. Power and Data Service Package: Manufacturer's standard service to individual seats including terminal devices and wiring with 18 inches of extra length and as follows.

1. Power Receptacles: 120 V with wiring and receptacle as specified in Division 16.
2. Data Ports: Data port terminal with wiring and receptacle jack as specified in Division 16.
3. Location: On raceway beneath the table surface.

F. Accessible Seating:

1. Provide tables without privacy panel at designated locations if panel encroaches into required ADA clearance

2.3 FABRICATION

A. Floor Attachments: Fabricate to conform to floor slope, if any, so that standards and pedestals are plumb and chairs are maintained at same angular relationship to vertical throughout Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine floors, risers, and other adjacent work and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Examine locations of HVAC supply ducts.

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

3.2 INSTALLATION

A. Install tables in locations indicated and fastened securely to substrates according to manufacturer's written installation instructions.

1. Use installation methods and fasteners that produce fixed tables assemblies capable of supporting an evenly distributed 600-lb static load without failure or other conditions that might impair the tables usefulness.
2. Install standards and pedestals plumb.

B. Install tables as indicated on drawings and to maximize sight lines.

C. Install wiring conductors and cables concealed in components of tables and accessible for servicing.

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.
2. Tests for Power Receptacles: As specified in Division 16 Sections.
3. Tests for Data Ports: As specified in Division 16 Sections.

B. Prepare test and inspection reports.

3.4 ADJUSTING

A. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.

END OF SECTION 12610

SECTION 13131 - BASIC TECHNOLOGY SYSTEMS REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for technology systems installations. The following administrative and procedural requirements are included in this Section:

1. Submittals.
2. Coordination drawings.
3. Record documents.
4. Maintenance manuals.
5. Rough-ins.
6. Technology systems installations.
7. Cutting and patching.

B. Related Sections: All division 13 sections contain requirements that relate to this section.

C. Related Sections: Several division 16 sections contain requirements that relate to this section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer licensed for the work to be performed in the state and/or locality in which the work is performed. Licenses shall be carried at all times and shown upon request. Installer shall be a dully authorized representative of the manufacturer of technology systems equipment.

1.4 SUBMITTALS

A. Provide eight copies of submittals. One copy will be retained by the technology systems Consulting Engineer.

1. Shop Drawings: 1 additional blue- or black-line prints.
2. Product Data: 1 additional copy of each item.

B. Additional copies may be required by individual sections of these Specifications.

1.5 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of technology systems equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Where deviations from contract documents are proposed, submit proposed changes prior to proceeding with the work.

1.6 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." Maintain during the course of construction a blue-line set of contract drawings and shop drawings in clean, undamaged condition, with mark-up of actual installations which vary

substantially from the work originally shown. Mark with red erasable pencil. Mark-up new information which is recognized to be of importance to Owner, but was for some reason not shown the drawings. Give particular attention to concealed work, which would be difficult to measure and record at a later date. In addition to the requirements specified in Division 1, indicate installed conditions for:

1. Redline changes or information from construction set.
2. Cable pathways, size and location.
3. Equipment locations.
4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.7 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 Section "PROJECT CLOSEOUT"; however, in no case shall fewer than 3 maintenance manuals in three ring binders be provided. In addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions charts and schedules.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Since the drawings of floor and ceiling installations are made at a small scale, outlets, devices, equipment, etc., are indicated only in their approximate location. Do not scale technology systems drawings. Refer to the architectural and mechanical drawings and dimensions. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions for rough-in requirements.

3.2 TECHNOLOGY SYSTEMS INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of technology systems, materials, and equipment. Comply with the following requirements:

1. Coordinate technology 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 technology systems 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 technology systems materials and equipment for efficient flow of the Work. Give particular attention to large equipment.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate and obtain written approval from Owner's representative at least 7 days in advance for technology systems service interruption.
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. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
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 technology systems equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.3 CUTTING AND PATCHING

A. General: Perform cutting and patching where required to complete the technology systems installation. Perform cutting and patching in compliance with the following requirements:

1. Perform cutting, fitting, and patching of technology systems equipment and materials required to:

   a. Uncover Work to provide for installation of ill-timed Work.
   b. Remove and replace defective Work.
   c. Remove and replace Work not conforming to requirements of the Contract Documents.
   d. Remove samples of installed Work as specified for testing.
   e. Install equipment and materials in existing structures.
   f. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.

2. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

3. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

4. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

5. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
   a. Refer to Division 1 Section "DEFINITIONS AND STANDARDS" for definition of experienced "Installer."

6. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

a. Refer to Division 1 Section "DEFINITIONS AND STANDARDS" for definition of experienced "Installer."

3.4 FINAL PUNCHLIST

A. General: In addition to the requirements of Division 1 for substantial completion, include the following:

1. Prerequisite personnel for technology systems final punchlist:

   a. Technology systems project engineer must be present.
   b. Technology systems installer job foreman must be present.
   c. Additional personnel may be required by other sections of this specification.

2. Other prerequisites for technology systems final punch list:

   a. List of incomplete items, value of incompletion, and reasons for being incomplete.
   b. Submit record drawings, record specifications, maintenance manuals, warranties, and summary test report.
   c. Deliver tools, spare parts, extra stocks of materials, and similar physical items to Owner. Provide delivery receipt signed by Owner's representative.
   d. Complete start-up testing of systems and instructions of Owner's operating/maintenance personnel.
   e. Clear access shall be provided to all devices and equipment.
   f. Installer shall have pad and pencil to list all deficient items noted.
   g. All corrections and adjustments shall be done after the inspection, not during. These items will appear on the final punch list.
   h. Required keys for panels and doors.

3. Comply with other prerequisites as specified in other sections of the specification.

END OF SECTION 13131

SECTION 13132 - BASIC TECHNOLOGY SYSTEMS MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements specified in Division 13 Section "Basic technology systems Requirements" apply to this Section.

1.2 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with technology systems installations as follows:

1. Selective demolition including:

   a. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
   b. Dismantling technology systems materials and equipment made obsolete by these installations.

2. Miscellaneous metals for support of technology systems materials and equipment.

3. Wood grounds, nailers, blocking, fasteners, and anchorage for support of technology systems materials and equipment.

4. Joint sealers for sealing around technology systems materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.

5. Access panels and doors in walls, ceilings, and floors for access to technology systems materials and equipment.

6. Painting of technology systems materials and equipment.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for the following products:

1. Joint sealers.

C. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for technology systems materials and equipment.

D. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of technology systems service, and details for dust and noise control.

1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."
2. Submit shop drawings indicating technology systems modifications to existing systems.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer for the installation. Refer to section 13 41 16.00 for definition of an experienced installer.

B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide UL listed assemblies to maintain specified rating where technology systems or technology systems components penetrate rated assemblies. Refer to manufacturers listed in the UL "Building Materials Directory" for rating shown. Products include, but are not limited to:

1. Access doors.
2. Conduit penetrations.
3. Communication outlets.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

1.6 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:

1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

2. Locate, identify, and protect technology systems services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do no apply joint sealers to wet substrates.

1.7 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of technology systems service with the Owner.

B. Notify the Architect at least 5 days prior to commencing demolition operations.

C. Perform demolition in phases as indicated.

1.8 PAINTING

A. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.

1. Painting includes field painting hangers, exposed steel and iron work, and primed metal surfaces of technology systems equipment.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.

F. Fasteners: Zinc-coated, type, grade, and class as required.

2.2 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less that 3/4 inches and painted with suitable fire rated paint material where required.

2.3 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire- rated walls and floors. Sealants and accessories shall have fire- resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

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

1. Bar-Co., Inc.
2. J.L. Industries.
3. Karp Associates, Inc.
4. Milcor Div. Inryco, Inc.
5. Nystrom, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION FOR JOINT SEALERS

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.3 SELECTIVE DEMOLITION

A. All obsolete technology systems equipment shall remain the property of the owner.

B. General: Demolish, remove, de-mount, and disconnect abandoned technology systems materials. Coordinate with other work, including technology systems wiring work, as necessary to interface installation of existing equipment with other work. New technology systems equipment and apparatus shall be coordinated and connected into the existing systems. Relocate existing technology systems devices, conduit and/or equipment that for any reason obstructs construction. All technology systems equipment and apparatus in the building not remodeled shall be connected and remain in working condition. Include any equipment having technology systems connections that requires disconnecting and re-connection at the same or another location throughout the course of construction.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor technology systems materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor technology systems materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

D. Install 4' X' X 3/4" plywood terminal boards in enclosures or mounted on walls as indicated.

3.6 SEISMIC BRACING

A. General: Provide vibration isolators, flexible connections, rigid steel frames, concrete inertia bases, anchors, inserts, hangers, and attachments, seismic bracing and snubbers as required for seismic control and prevention of the transmission of vibration for both isolated and non-isolated systems. Comply with seismic requirements for the proper seismic zone for all support systems.
   1. Vibration isolated equipment shall be mounted on rigid steel frames or concrete bases. Each spring mounted base shall have a minimum of four all directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. The snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications.
   2. Non-isolated equipment shall be installed according to UBC Sec. 2312 (g); Cp Factor Table 23J, I Factor Table 23K.4.C In addition, the vertical forces restrain requirements shall be computed as the ½ the value of the horizontal forces.

3.7 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.

2. Comply with recommendations of ASTM C 790 for use of acrylic- emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around technology systems services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

END OF SECTION 13132

SECTION 13134 - AUDIO SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Comply with UVU Master Spec

C. Related Sections: The following division 13 sections contain requirements that relate to this section:

1. General Technology Systems Requirements
2. Basic Technology Systems Requirements
3. Basic Technology Systems Materials and Methods
4. Video Systems
5. Control Systems

D. Related Sections: Several sections of division 16 contain requirements that relate to this section.

1.2 SUMMARY

A. The audio system will provide for voice amplification and media device audio program amplification. Media device audio program and voice audio amplification will originate from various media sources and microphones, be switched through a source selection switcher, and/or be mixed, processed and amplified to the speaker system. In addition where specified, tele-conferencing for distance education is provided.

B. Installation shall comply with all Utah Valley University Standards. All systems and installation shall be carefully coordinated with Travis Tasker of Media Services.

C. This Section includes requirements for audio system components including, but not limited to, the following:

1. Microphones
2. Mixers
3. Power Amplifiers
4. Cabinets
5. Racks
6. Speaker Systems
7. Wiring
8. Microphone Inputs
9. Processors
10. Combiners

1.3 SYSTEM DESCRIPTION

A. General: The audio system shall be a complete system for amplifying sound signals from microphones and media source equipment and distributing them to loudspeakers at various locations.

B. Functional Performance: Components and system features and functions shall include, but are not limited to, the following:

1. Meet the following performance parameters as measured in 1/3 octave bands:

   a. From 100 Hz to 2kHz, flat within plus or minus 2dB.
   b. Above 2kHz, slope down along an approximate 3dB octave slope to 8kHz.

2. Sound pressure levels at 2kHz octave band shall not deviate more than plus or minus 2dB.
3. When driven to maximum output, clipping shall first occur in power amplifiers.
4. No noise, hum, RFI pickup or distortion shall be audible under normal operating conditions.
5. Sound system shall reproduce program material at a level of 90 dBA without audible distortion.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1. Product data for each type of product specified.
2. Shop drawings detailing audio system including, but not limited to the following:

   a. Connection panels.
   b. Rack elevations showing component arrangement inside equipment racks.

3. Wiring Diagrams detailing wiring for power, signal, and control differentiating clearly between manufacturer-installed wiring and field-installed wiring. Identify terminal numbers and wiring color codes to facilitate installation, operation, and maintenance.
4. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 13 Section "Basic A/V System Requirements." Provide complete operations and maintenance manual material concurrently with system submittal and provide updated final versions of manuals one month before completion of construction and final system turnover. Include the following:

   a. Equipment list showing quantity, make, model, and serial number.
   b. System operating instructions.
   c. System maintenance instructions.

5. Wiring codes for all system cable. (See "labeling", this section).
6. Proposed labeling for system components. (See "labeling", this section).
7. All special submittal instructions indicated on supplied design drawings.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of sound system, components and accessories, of types, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience of A/V system projects similar to that required for this project. In addition, installers must have successfully completed a minimum of 3 similar installations over a period of 2 years prior to the date of the bid opening for this project. System installations must have included similar automatic mixers, matrices, and echo cancellors hardware and software. To qualify as similar, audio systems must have included complete installation, set up, programming, balancing, and equalization of automatic mixers, matrix routers, echo cancellors, and digital audio processors. All such installation, set up, programming, balancing, and equalization work must have been completed by a factory trained and certified technician of the specified mixer, matrix, echo cancellor, and digital audio processor manufacturer. The certified technician must have successfully completed all relevant training courses recommended by the manufacturers of the

above referenced equipment for proficiency in these skill sets. In addition, the certified technician must have been, and now be, a direct employee of the installer, in a permanent office staffed with factory qualified technicians, working for a minimum of 40 hours per week as a direct employee of the installer. The certified technician and factory trained installers must be the direct employees of the installer; sub-contracted, third party maintenance agreements, or similar arrangements are expressly prohibited, and do not qualify. Upon request, submit evidence of such qualifications to the A/V Consultant. All of the above requirements must be complied with prior to the bid opening for this project.

C. Electrical Component Standard: Provide work complying with applicable requirements of NFPA 70 "National Electrical Code."

D. EIA Compliance: Comply with the following Technology Industries Association Standards:

1. Sound Systems, EIA-160.
2. Loudspeaker, Dynamic Magnetic Structures, and Impedance, EIA-299-A.
3. Racks, Panels, and Associated Equipment, EIA-310-A.
4. Amplifiers for Sound Equipment, SE-101-A.
5. Speakers for Sound Equipment, SE-103.
6. Microphones for Sound Equipment, SE-105.

E. UL Compliance: Comply with requirements of UL 50.

F. All installation practices shall be in accordance with, but not limited to, these specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of the Uniform Building Code, the National Electrical Code and all local authorities having jurisdiction. All installation work shall follow "standard broadcast wiring" and installation practices, as excerpted from "Recommended Wiring Practices," Sound System Engineering, (2nd Edition), D. Davis, and performed to the highest standards of acknowledged industry practices.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in factory containers. Store in clean, dry space in original containers. Protect products from fumes and construction traffic. Handle carefully to avoid damage.

1.7 WARRANTY REQUIREMENTS

A. Audio system shall be subject to warranty requirements as stated in Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by those manufacturers identified in the equipment list. Firms regularly engaged in manufacture of sound system components and accessories, of types, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. All equipment and material shall be new, and must have been commercially available for at least one year prior to bid.

C. All equipment must be UL listed or built to UL standards.

2.2 SYSTEM REQUIREMENTS

A. General: Provide complete and fully functional audio systems using materials and equipment of types, sizes, ratings, and performances as indicated in the equipment list in the accompanying drawings. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction in accordance with published product information. Coordinate the features of materials and equipment so they form an integrated system with components and interconnections matched for optimum performance of specified functions.

B. Provide all wire, cable, and connectors as required to complete the installation of all systems as designed and specified.

2.3 EQUIPMENT AND MATERIALS

A. General: Provide equipment selected from equipment list on drawings, using all solid-state components fully rated for continuous duty at the ratings indicated or specified. Select equipment for normal operation on input power supplied at 105-130 V, 60 Hz.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the Audio System work.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.

B. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three times the weight of the equipment being installed. Any structural mounting that is not able to meet this requirement due to the specific nature of the equipment, manufacturer's requirements or limitations of the facility, shall not be installed without prior approval of the Engineer. Install all boxes, equipment, hardware, and other materials plumb, level, and square.

C. Install all technology equipment and support equipment in podium, and the other millwork in a neat and cosmetically dressed-out manner. All saw cuts, holes and recesses into laminates and woodwork shall be straight, all radius and circular cuts shall be consistent, and all uneven surfaces shall be corrected. This shall include the use of moldings, grommets, bushings, laminates, and wood products as required to dress out the installation of equipment. Assure that the installation of equipment and panels in the technology racks and podiums are completed by using matching screws, hardware and grommets.

D. Speakers:

1. Confirm polarity of speaker before installation and wire to maintain uniform polarity.
2. Mount transformers with screws securely to speaker brackets or enclosures.
3. Neatly mount speaker grilles, panels, connector plates, control panels, etc., tight, plumb, and square unless indicated otherwise on drawings.
4. Provide brackets, screws, adapters, springs, rack mounting kits, etc., recommended by manufacturer for correct assembly and installation of speaker assemblies and technology components.
5. Make speaker cable connections with rosin core solder or wire nut or equivalent connections.

6. Loosely but completely fill speaker back boxes that do not have fiberglass installed with fiberglass.
7. Seal cone speakers to backbox so air will not pass from one side of speaker to another.
8. Securely mount theater style speaker systems to custom wall mount brackets as detailed in the supplied design drawings. Comply with applicable seismic codes and requirements.

E. Technology:

1. Assure sufficient ventilation for adequate cooling of equipment.
2. Mount amplifiers at top of equipment cabinet. Install vent rack panels in unused spaces. Install vent panels at top and bottom and above each power amplifier.
3. Securely fasten equipment plumb and square in place. Where equipment is installed in rack cabinets, utilize all fastening holes and cover open spaces with perforated panels.
4. Securely fasten relays and small components. Do not use sticky-back tape for fasteners.
5. Install balancing transformer on each unbalanced input or output that connects to device outside equipment cabinet, or that connects to balanced input or output within equipment cabinet.
6. Connect powered components to 120 VAC outlets on transient voltage surge suppressors. Do not connect to outlets on other components.
7. Leave sufficient service loops of uniform length on cables to allow operation of system with chassis outside cabinet.
8. All equipment shall be held firmly in place with proper types of mounting hardware as recommended and/or supplied by the manufacturer. All mounting hardware provided with equipment shall be used when practical. This shall include, but not be limited to, front and rear rack rails, angle brackets and rack mount kits. All equipment shall be installed so as to provide reasonable safety to the operator. The Lessor shall supply adequate ventilation for all enclosed equipment items which produce heat.

F. Cable, Wire, and Connectors:

1. All cable and wire shall be new and unspliced. Splicing of cables and conductors is expressly prohibited in any location other than the equipment racks. Splicing of audio and video cables will not be allowed in any location. Splicing of control conductors shall be accomplished via punch block or terminal strip connections only.
2. Additional cable length shall be provided at all connector locations. Duplex box, junction box, and floor box locations shall be installed with sufficient cable length behind cover plates to permit wiring maintenance and connector replacement in the future.
3. When cable runs utilize the vertical cable raceways located within walls, the acoustic integrity of the walls shall be maintained. All cables that pass through cover plates of junction boxes and raceways, through slab-to-slab walls, and through conduit lines shall be properly gasketted and sealed and all acoustic material shall be restored or replaced.
4. Separation between system cables and all other services shall be maximized to prevent and/or minimize the potential for electro-magnetic interference (EMI). Particular care shall be taken to ensure at least a 12" separation from electrical lines whenever feasible. At points where separation is unavoidable, distribution cables shall cross other services at right angles whenever practical to minimize EMI.
5. Cables shall be installed in a manner that shall ensure no signal cables are placed on top of any lighting fixtures, ceiling speakers, video projector lifts, projection screens, HVAC controls or sensing devices, fire safety and sprinkler system detection technology, or any other technology or mechanical equipment.
6. No cables shall be laid directly on top of T-bar grid ceiling tiles.
7. System cables shall be installed in a manner that will not block access to other equipment or services, across removable service panels and/or in any other manner to prohibit routine maintenance of HVAC systems, fire safety equipment and building mechanical control systems.
8. All exposed cable shall be dressed with heavy duty neoprene heat-shrink tubing.

9. All inter-rack cabling shall be neatly laced, dressed, strain relieved and adequately supported.
10. After completion of wiring and cable installation, all trough and box covers shall be notched out and grommeted for clearance of the various cable bundles, (i.e., separate audio, video, and control). These panel covers shall be screwed back in place and all gaskets shall be restored or replaced.
11. Do not place any wires and cables for this system in any conduit, raceway, wireway or cable tray that is used for the mechanical systems of the building.
12. Provide connectors of the type and quality as detailed in this contract, and/or as required to meet the minimum bandwidth requirements of the equipment to which the connectors are terminated. The overall quantity of connectors shall not be limited by the quantities indicated in the drawings and shall be provided as required.
13. No connectors shall be installed in non-accessible locations or used for splicing cables. All connectors shall be new.
14. All connectors shall incorporate strain relief mechanisms which firmly grip the jacket of connected cables. All connectors shall be properly polarized to prevent improper seating. Connectors shall provide appropriate electrical characteristics for the circuitry to which they are attached.
15. All inner-rack cables shall be grouped according to the signals being carried to reduce signal contamination. Separate groups shall be formed for the following:

    a. Power
    b. Control
    c. Video
    d. Audio cables carrying signals less than -20 dBM.
    e. Audio cables carrying signals between -20 dBM and +20 dBM.
    f. Audio cables carrying signals over +20 dBM.

16. Route all cable and wiring within equipment racks, cabinets and millwork according to function, separating wires of different signal levels (microphone, line level, amplifier output, AC, control, etc.) by as much distance as possible. Neatly arrange, harness and bundle all cable with nylon U/V rated ties.
17. As a general practice, all power cables, control cables, and high level cables shall be run on the left side of equipment racks as viewed from the rear. All other cables shall be run on the right side of all equipment racks as viewed from the rear.
18. All cables, except video cables which must be cut to an electrical length, shall be cut to the length dictated by the cable run.
19. Terminal blocks, boards, strips or connectors, shall be furnished by the installer for all cables which interface with racks, cabinets, consoles, or equipment modules. Affix terminal blocks, boards, strips or connectors to equipment racks using screws only. Double sided tape will not be accepted.
20. Comply with industry standard circuit polarity and loudspeaker wiring polarity. No cables shall be terminated with a polarity reversal between connectors at either end.
21. All system wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No bare wire ends shall be accepted.
22. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables including a separate tube for the ground or drain wire.
23. All solder connections shall be made with rosin-core solder. Temperature controlled soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns, gas or butane, or temperature unregulated irons shall be used on the job site.
24. The presence of such soldering tools on the job site shall constitute evidence of solder connections made with unauthorized tools and shall provide sufficient grounds for rejection of all solder connections in the system, and the subsequent re-work of same
25. All mechanical connections shall be made with approved crimp lugs of the correct size and type for the connection. Wire nuts shall not be permitted. Each connector shall be attached with the proper size controlled-duty-cycle ratcheting crimp tool which has been approved by the manufacturer of the connectors.

26. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on the job site. The presence of such tools on the job site shall constitute evidence of mechanical connections made with unauthorized tools and shall provide sufficient grounds for rejection of all mechanical connections in the system, and the subsequent re-work of same.
27. Shields for audio cables shall be grounded at the input end only, of the various equipment items on the system to prevent potential for ground loops.

G. Identification and Labeling:

1. All cables, regardless of length, shall be marked with wrap-around number or letter cable markers at both ends. These labels shall be self laminating to ensure durability. The label format used shall be equal, or better than, the system detailed.
2. There shall be no unmarked cables any place in the system.
3. Labels shall indicate signal type.
4. Marking codes used on cables shall correspond to codes provided with submittals, and/or the written documentation of the "as built" drawings.
5. All connectors, controls, equipment components, terminal blocks and equipment racks are to be permanently labeled in a format approved during the submittal process.
6. All equipment labels are to be permanently engraved in metal. Any alternative method shall be approved during the submittal process.
7. Clearly and permanently label all jacks, controls, connections, and so forth. Embossed or printed label tape shall not be used and is considered unacceptable for this system. Attach labels with double stick tape as required.
8. All labeling shall be completed prior to acceptance of the final system.

H. Repairs: Wherever walls, ceilings, floors, or other building finishes are cut for installation, or accidentally marred during installation, repair, restore, and refinish to original appearance.

3.3 GROUNDING

A. Provide equipment grounding connections for audio system as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to eliminate ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

C. Provide one #10 ground conductor with green insulation between all equipment racks and the main electrical panel ground bus. Connect at each end.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Pretesting: Upon completing installation of the system, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new, and retest until materials satisfactory performance and conditions are achieved.

C. Balance and Equalization: Perform the final balance and equalization. Comply with the equalization requirements stated above.

D. A/V Consultant Final Review:

1. Contractor shall assist A/V Consultant in performing the final review, and spot checking the balance and equalization.
2. Coordinate final inspection schedule with A/V Consultant two weeks minimum prior to Consultant's final inspection.
3. Have copy of red-lined as-built documents available at time of inspection.
4. Have loose equipment (microphones, cables, etc) available at time of inspection.
5. Assist Sound/Acoustic Consultant in final inspection of completed system.
6. Provide the following test equipment in good working order:

    a. Battery operated hand-held 1/3 octave real-time audio spectrum analyzer with SPL meter and precision microphone.
    b. Digitally generated random pick noise generator, 20Hz-20kHz, minimum 2 hr repetition rate.
    c. Direct reading audio impedance meter, minimum 3 frequencies, 10% accuracy.
    d. Digital Volt-Ohmmeter.
    e. Audio oscillator, variable frequency, 20Hz-20kHz.
    f. Battery operated oscilloscope, 1 MHz minimum bandwidth.
    g. Necessary charger, cables, test leads, adapter, power strip, etc, for test equipment.

7. Correct minor items so A/V Consultant may certify satisfactory completion during his visit.
8. Pay Consultant's additional fees and expenses if building or system have not been completed properly or sufficiently, requiring A/V Consultant to make subsequent visits to balance, equalize, inspect, or certify completion.

3.5 COMMISSIONING

A. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. Provide a minimum of six hours training.

B. Schedule training with Owner through the Architect, with at least 7 days advance notice.

C. Occupancy Adjustments: When requested by the Owner or the A/V Consultant within one year of date of substantial completion, provide on-site assistance in adjusting sound levels, resetting matching transformer taps, and adjusting controls to suit actual occupied conditions. Provide up to three visits to the site for this purpose at no additional cost to the owner.

3.6 CLEANING AND PROTECTION

A. Prior to final acceptance, clean system components and protect from damage and deterioration.

END OF SECTION 13134

SECTION 13136- VIDEO SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to this Section.

B. Related Sections: The following division 13 sections contain requirements that relate to this section:

1. General Technology Systems Requirements
2. Basic Technology Systems Requirements
3. Basic Technology Systems Materials and Methods
4. Audio Systems
5. Control Systems

C. Related Sections: Several sections of division 16 contain requirements that relate to this section.

1.2 SUMMARY

A. The video system will provide for large screen projection of multiple media sources. Video and data signals will originate in media devices, be processed, selected and displayed. In addition where specified, video conferencing for distance education is provided.

B. Installation shall comply with all Utah Valley University Standards. All systems and installation shall be carefully coordinated with Travis Tasker of Media Services.

C. This Section includes requirements for video system components including, but not limited to, the following:

1. Video/data Projectors
2. Front Projection Screens and Mirror Systems
3. Distribution Switchers
4. Matrix Switchers
5. Video Conferencing CODECs
6. Cameras
7. Computer Interfaces
8. Various Media Source Devices
9. Monitors
10. Video Distribution Systems
11. Racks
12. Wire, Cable, and Connectors

1.3 SYSTEM DESCRIPTION

A. General: The video system shall be a complete system for the large screen projection and monitoring of video, data, and graphics signals.

B. Video/Data Functional Performance: Components and system features and functions shall include, but not be limited to:

1. Processing, routing and display of any video, data, or graphic signal up to and including native resolutions of 1920 by 1200.

2. Large screen projection systems.
3. Video conferencing.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of product specified.

C. Shop drawings detailing video system including, but not limited to the following:

a. Connection panels.
b. Rack elevations showing component arrangement inside equipment racks.
c. Shop drawings which identify proposed projector lift and electric roll up screen mounting details.

2. Wiring Diagrams detailing wiring for power, signal, and control differentiating clearly between manufacturer-installed wiring and field-installed wiring. Identify terminal numbers and wiring color codes to facilitate installation, operation, and maintenance.
3. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 13 Section "Basic Technology Systems Requirements." Provide complete operations and maintenance manual material concurrently with system submittal and provide updated final versions of manuals one month before completion of construction and final system turnover. Include the following:

a. Equipment list showing quantity, make, model, and serial number.
b. System operating instructions.
c. System maintenance instructions.

4. Wiring codes for all system cable. (See "labeling", this section).
5. Proposed labeling for system components. (See "labeling", this section).
6. All special submittal instructions indicated on supplied design drawings.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of video system, components and accessories, of types, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience of A/V system projects similar to that required for this project. In addition, installers must have successfully completed a minimum of 3 similar installations over a period of 2 years prior to the date of the bid opening for this project. System installations must have included similar switchers, matrices, scalers, processors, CODECS, and projectors. To qualify as similar, video systems must have included complete installation, set up, programming, calibration, and equalization of switchers, matrix routers, scalers, processors, CODECS, and projectors. All such installation, set up, programming, calibration, and equalization work must have been completed by a factory trained and certified technician of the specified switchers, matrix routers, scalers, processors, CODECS, and projectors manufacturer. The certified technician must have successfully completed all relevant training courses recommended by the manufacturers of the above referenced equipment for proficiency in these skill sets. In addition, the certified technician must have been, and now be, a direct employee of the installer, in a permanent office staffed with factory qualified technicians, working for a minimum of 40 hours per week as a direct employee of the installer. The certified technician and factory trained installers must be the direct employees of the installer; sub-contracted, third party maintenance agreements, or

similar arrangements are expressly prohibited, and do not qualify. Upon request, submit evidence of such qualifications to the A/V Consultant. All of the above requirements must be complied with prior to the bid opening for this project.

C. Electrical Component Standard: Provide work complying with applicable requirements of NFPA 70 "National Electrical Code."

D. EIA Compliance: Comply with the following Technology Industries Association Standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in factory containers. Store in clean, dry space in original containers. Protect products from fumes and construction traffic. Handle carefully to avoid damage.

1.7 WARRANTY REQUIREMENTS

A. Video system shall be subject to warranty requirements as stated in Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by those manufacturers identified in the equipment list.

2.2 SYSTEM REQUIREMENTS

A. General: Provide a complete and fully functional video system using materials and equipment of types, sizes, ratings, and performances as indicated in the project drawings. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction in accordance with published product information. Coordinate the features of materials and equipment so they form an integrated system with components and interconnections matched for optimum performance of specified functions.

B. Video Projection System: Provide complete projection system set up services including but not limited to convergence, focusing, preset programming, and alignment. Include manufacturer direct services and on site support.

1. Set Up: Provide complete setup and convergence services as defined in the manufacturer’s installation manual. Assure that all display devices automatically lock onto all owner designated horizontal scan frequencies and save to memory locations. Provide all equipment required to accomplish programming. At a minimum, without implying limitation, and in addition to those horizontal scan frequencies requested by the owner during the final system set up phase, program display systems to automatically lock onto horizontal scan frequencies for the following resolutions:

a. NTSC
b. CGA
c. VGA
d. EGA
e. SVGA
f. XGA
g. WXGA
h. SXGA
i. UXGA
j. WUXGA

k. MAC II
l. MAC QUADRA
m. IBM workstations
n. UNIX workstations
o. SUN workstations
p. All HD Formats

2. Mounting, Alignment, and Focusing: Provide all mounting brackets, threaded rod, unistrut, fasteners, and associated mounting hardware to securely affix the projector/lift to building structure. Suspend the projector/lift in compliance with industry recognized rigging procedures and in compliance with seismic codes. Coordinate exact mounting location with architect, mechanical and electrical. Align projector with the optical center of the screen and focus the video projector in relation to the image size, mounting systems, and video projection screen. All images shall be level, square, and aligned for optimum overall positioning with respect to the optical center line. Use of keystone correction is not allowed.

3. All projected images shall be free of visible vibration and/or motion. Provide vibration isolation and dampening equipment where required.

2.3 EQUIPMENT AND MATERIALS

A. General: Provide equipment selected from equipment list on drawings, using all solid-state components fully rated for continuous duty at the ratings indicated or specified. Select equipment for normal operation on input power supplied at 105-130 V, 60 Hz.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the video system work.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.

B. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three times the weight of the equipment being installed. Any structural mounting that is not able to meet this requirement due to the specific nature of the equipment, manufacturer's requirements or limitations of the facility, shall not be installed without prior approval of the Architect. Install all boxes, equipment, hardware, and other materials plumb, level, and square.

C. Install all technology equipment and support equipment in all podiums, and the other millwork in a neat and cosmetically dressed-out manner. All saw cuts, holes and recesses into laminates and woodwork shall be straight, all radius and circular cuts shall be consistent, and all uneven surfaces shall be corrected. This shall include the use of moldings, grommets, bushings, laminates, and wood products as required to dress out the installation of equipment. Assure that the installation of equipment and panels in the technology racks and podiums are completed by using matching screws, hardware and grommets.

D. Electronics:

1. Assure sufficient ventilation for adequate cooling of equipment.
2. Install vent rack panels in unused spaces.
3. Securely fasten equipment plumb and square in place. Where equipment is installed in rack cabinets, utilize all fastening holes and cover open spaces with perforated panels.
4. Securely fasten relays and small components. Do not use sticky-back tape for fasteners.
5. Install balancing transformer on each unbalanced input or output that connects to device outside equipment cabinet, or that connects to balanced input or output within equipment cabinet.
6. Connect powered components to 120 VAC outlets on transient voltage surge suppressors. Do not connect to outlets on other components.
7. Leave sufficient service loops of uniform length on cables to allow operation of system with chassis outside cabinet.
8. All equipment shall be held firmly in place with proper types of mounting hardware as recommended and/or supplied by the manufacturer. All mounting hardware provided with equipment shall be used when practical. This shall include, but not be limited to, front and rear rack rails, angle brackets and rack mount kits. All equipment shall be installed so as to provide reasonable safety to the operator. The Lessor shall supply adequate ventilation for all enclosed equipment items which produce heat.

E. Cable, Wire, and Connectors:

1. All cable and wire shall be new and unspliced. Splicing of cables and conductors is expressly prohibited in any location other than the equipment racks. Splicing of audio and video cables will not be allowed in any location. Splicing of control conductors shall be accomplished via punch block or terminal strip connections only.
2. Additional cable length shall be provided at all connector locations. Duplex box, junction box, and floor box locations shall be installed with sufficient cable length behind cover plates to permit wiring maintenance and connector replacement in the future.
3. When cable runs utilize the vertical cable raceways located within walls, the acoustic integrity of the walls shall be maintained. All cables that pass through cover plates of junction boxes and raceways, through slab-to-slab walls, and through conduit lines shall be properly gasketted and sealed and all acoustic material shall be restored or replaced.
4. Separation between system cables and all other services shall be maximized to prevent and/or minimize the potential for electro-magnetic interference (EMI). Particular care shall be taken to ensure at least a 12" separation from electrical lines whenever feasible. At points where separation is unavoidable, distribution cables shall cross other services at right angles whenever practical to minimize EMI.
5. Cables shall be installed in a manner that shall ensure no signal cables are placed on top of any lighting fixtures, ceiling speakers, video projector lifts, projection screens, HVAC controls or sensing devices, fire safety and sprinkler system detection technology, or any other technology or mechanical equipment.
6. No cables shall be laid directly on top of T-bar grid ceiling tiles.
7. System cables shall be installed in a manner that will not block access to other equipment or services, across removable service panels and/or in any other manner to prohibit routine maintenance of HVAC systems, fire safety equipment and building mechanical control systems.
8. All exposed cable shall be dressed with heavy duty neoprene heat-shrink tubing.
9. All inter-rack cabling shall be neatly laced, dressed, strain relieved and adequately supported.
10. After completion of wiring and cable installation, all trough and box covers shall be notched out and grommeted for clearance of the various cable bundles, (i.e., separate audio, video, and control). These panel covers shall be screwed back in place and all gaskets shall be restored or replaced.
11. Do not place any wires and cables for this system in any conduit, raceway, wireway or cable tray that is used for the mechanical systems of the building.

12. Provide connectors of the type and quality as detailed in this contract, and/or as required to meet the minimum bandwidth requirements of the equipment to which the connectors are terminated. The overall quantity of connectors shall not be limited by the quantities indicated in the drawings and shall be provided as required.
13. No connectors shall be installed in non-accessible locations or used for splicing cables. All connectors shall be new.
14. All connectors shall incorporate strain relief mechanisms which firmly grip the jacket of connected cables. All connectors shall be properly polarized to prevent improper seating. Connectors shall provide appropriate electrical characteristics for the circuitry to which they are attached.
15. All inner-rack cables shall be grouped according to the signals being carried to reduce signal contamination. Separate groups shall be formed for the following:

    a. Power
    b. Control
    c. Video
    d. Audio cables carrying signals less than -20 dBM.
    e. Audio cables carrying signals between -20 dBM and +20 dBM.
    f. Audio cables carrying signals over +20 dBM.

16. Route all cable and wiring within equipment racks, cabinets and millwork according to function, separating wires of different signal levels (microphone, line level, amplifier output, AC, control, etc.) by as much distance as possible. Neatly arrange, harness and bundle all cable with nylon U/V rated ties.
17. As a general practice, all power cables, control cables, and high level cables shall be run on the left side of equipment racks as viewed from the rear. All other cables shall be run on the right side of all equipment racks as viewed from the rear.
18. All cables, except video cables which must be cut to an electrical length, shall be cut to the length dictated by the cable run.
19. Terminal blocks, boards, strips or connectors, shall be furnished by the installer for all cables which interface with racks, cabinets, consoles, or equipment modules. Affix terminal blocks, boards, strips or connectors to equipment racks using screws only. Double sided tape will not be accepted.
20. Comply with industry standard circuit polarity and loudspeaker wiring polarity. No cables shall be terminated with a polarity reversal between connectors at either end.
21. All system wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No bare wire ends shall be accepted.
22. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables including a separate tube for the ground or drain wire.
23. All solder connections shall be made with rosin-core solder. Temperature controlled soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns, gas or butane, or temperature unregulated irons shall be used on the job site.
24. The presence of such soldering tools on the job site shall constitute evidence of solder connections made with unauthorized tools and shall provide sufficient grounds for rejection of all solder connections in the system, and the subsequent re-work of same.
25. All mechanical connections shall be made with approved crimp lugs of the correct size and type for the connection. Wire nuts shall not be permitted. Each connector shall be attached with the proper size controlled-duty-cycle ratcheting crimp tool which has been approved by the manufacturer of the connectors.
26. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on the job site. The presence of such tools on the job site shall constitute evidence of mechanical connections made with unauthorized tools and shall provide sufficient grounds for rejection of all mechanical connections in the system, and the subsequent re-work of same.
27. Shields for audio cables shall be grounded at the input end only, of the various equipment items on the system to prevent potential for ground loops.

F. Identification and Labelling:

1. All cables, regardless of length, shall be marked with wrap-around, or better, number or letter cable markers at both ends. These labels shall be self laminating to ensure durability. The label format used shall be equal, or better than, the system detailed.
2. There shall be no unmarked cables any place in the system.
3. Marking codes used on cables shall correspond to codes provided with submittals, and/or the written documentation of the "as built" drawings.
4. All connectors, controls, equipment components, terminal blocks and equipment racks are to be permanently labeled in a format approved during the submittal process.
5. All equipment labels are to be permanently engraved in metal or plastic laminate and affixed with double-stick tape. Any alternative method shall be approved during the submittal process.
6. Clearly and permanently label all jacks, controls, connections, and so forth, with engraved laminated plastic labels. Embossed or printed label tape shall not be used and is considered unacceptable for this system. Attach labels with double stick tape as required.
7. All labeling shall be completed prior to acceptance of the final system.

G. Repairs: Wherever walls, ceilings, floors, or other building finishes are cut for installation , repair, restore, and refinish to original appearance.

3.3 GROUNDING

A. Provide equipment grounding connections for satellite earth-station systems and components, including dish antenna and supporting structures, and lead-in wires to antenna-discharge units. Tighten connections in accordance with manufacturer's recommended tightening torques. If not manufacturer-specified, comply with tightening torques specified in UL Stds 486A and B to assure permanent and effective grounds.

B. Provide equipment grounding connections for audio system as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

C. Ground equipment, conductor, and cable shields to eliminate shock hazard and to eliminate ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

D. Provide one #10 ground conductor with green insulation between all equipment racks and the main electrical panel ground bus. Connect at each end.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Pretesting: Upon completing installation of the system, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new, and retest until materials satisfactory performance and conditions are achieved.

C. A/V Consultant Final Review & Equalization:

1. Contractor shall assist A/V Consultant in performing the final balance, equalization, and review.
2. Coordinate final inspection schedule with A/V Consultant two weeks minimum prior to Consultant's final inspection.
3. Have copy of red-lined as-built documents available at time of inspection.
4. Have loose equipment (microphones, cables, etc) available at time of inspection.
5. Assist Sound/Acoustic Consultant in final inspection of completed system.
6. Provide the following test equipment in good working order:

    a. Digitally generated test signal generator for all signals identified above.
    b. Digital Volt-Ohmmeter.
    c. Field strength meter.
    d. Battery operated oscilloscope, 1 MHz minimum bandwidth.
    e. Necessary charger, cables, test leads, adapter, power strip, etc, for test equipment.

7. Correct minor items so A/V Consultant may certify satisfactory completion during his visit.
8. Pay Consultant's additional fees and expenses if building or system have not been completed properly or sufficiently, requiring A/V Consultant to make subsequent visits to balance, equalize, inspect, or certify completion.

3.5 COMMISSIONING

A. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. Provide a minimum of eight hours training.

B. Schedule training with Owner through the Architect, with at least 7 days advance notice.

C. Occupancy Adjustments: When requested by the Architect or the A/V Consultant within one year of date of substantial completion, provide complete auto convergence services, on-site assistance in adjustment of signal levels, and adjusting controls to suit actual occupied conditions. Provide up to six visits to the site for this purpose at no additional cost to the owner.

3.6 CLEANING AND PROTECTION

A. Prior to final acceptance, clean system components and protect from damage and deterioration.

END OF SECTION 13136

SECTION 13138 - CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to this Section.

B. Related Sections: The following division 13 sections contain requirements that relate to this section:

1. General Technology Systems Requirements
2. Basic Technology Systems Requirements
3. Basic Technology Systems Materials and Methods
4. Audio Systems
5. Video Systems

C. Related Sections: Several sections of division 16 contain requirements that relate to this section.

1.2 SUMMARY

A. The control system will be a microprocessor based, modular card frame and card system, with control system intercommunication via a serial loop. Human interface will occur through color, programmable touch screen control panel(s), and/or miscellaneous control panels. The control system will control all room A/V functions and equipment, as well as dimmer packs for the room lighting system. The control system will interface to components via infra-red, serial, and contact closure control signals. The control system will include all hardware, firmware, software, and programming to provide complete system control functions including but not limited to all requirements specified in the programming outline included herein.

B. Installation shall comply with all Utah Valley University Standards. All systems and installation shall be carefully coordinated with Travis Tasker of Media Services. Control system pages and programming shall match existing templates and system currently on campus.

C. This Section includes requirements for control system components including, but not limited to, the following:

1. Touch Panels
2. Control Panels
3. Modular card frame systems
4. Control cards
5. Volume controllers
6. General bus devices
7. Racks
8. Wire, Cable, and Connectors

D. Related Sections: The following division 13 and division 26 sections contain requirements that relate to this section:

1. General Technology Systems Requirements
2. Basic Technology Systems Requirements
3. Basic Technology Systems Materials and Methods
4. Audio System
5. Video
6. Technology Systems Electrical

1.3 SYSTEM DESCRIPTION

A. Comply with the Control System Programming Outline in developing the software programming for control system operations. The programming outline provides an in-depth narrative which describes the touch panel page design and specific button operating details. All general A/V systems functions will be associated with a specific color. For example, in the common button bar(s), each button will be a different color. When access is gained into control pages, the same color will be carried through to show related functions and controls. All touch panel buttons, graphics, and page configurations shall be developed and designed by the installer as required to produce a fully functioning system. All final page layouts shall be approved by the A/V Consultant and the Owners representative prior to final programming. This shall include all "help" pages, and all new pages and/or buttons which may not be described in the programming outline, but, nevertheless are required to provide a fully functional A/V control system. Submit proposed page layouts for approval in conjunction with the specified submittal process. The intent of the programming outline is not to eliminate the field engineering required of the contractor, but rather to give a clear course of logic desired for the touch panel buttons and pages. Include an quthenticatoin page using UVID's

B. The control panels shall communicate with all specified A/V system components via the specified control system devices.

C. Where applicable, the control system software will be written to include the video conference code as a single block of programming. All other A/V system code will be written as a separate block, and added to the code for video conferencing code. Provide sufficient "remark statements" to identify various blocks of code.

D. The fluorescent and/or incandescent overhead lights in each room shall be controlled by the control system.

E. The Installer shall provide the complete and final source code to the Owner for the completed functioning control system. In addition, the Installer must relinquish ownership of said software code and all touch panel pages, in writing, to the Owner.

F. The control system shall be an all digital touch panel system which permits easy operation of all room functions from a single unified panel. This shall include all "technician level" set-up parameters, default settings, presets, and other operational functions as described in this specification and/or required to accomplish fully functioning system.

G. The control system shall include complete help functions as detailed in the Control System Programming Outline.

H. The control system shall include operation of power controllers to energize the designated rack mounted system equipment per the Control System Programming requirements, and the system installation guidelines.

I. The control system hardware shall be supplied by a manufacturer that offers factory-level training in advanced control operations and system programming. This training shall be available to enable the Owner's technical staff to acquire the technician-level skills needed to maintain the control system, and make programming modifications after the initial programming and installation of these system at the completion of the warranty period.

J. The control system, and its associated equipment, shall interface and operate all equipment and devices, as detailed in the control system programming outline, and as illustrated in the supplied design drawings including, but not limited to lighting dimmers, video cassette recorder/players, Mixers, audio cassette players, compact disc players, document cameras, power controllers, volume controllers, satellite receivers, source selection switchers, signal scalers, video projectors, conferencing equipment, and any and all other system devices as required.

K. The control system touch panel system shall include a "technician level" of operation separate from the "user level" of operation. This shall be provided to prevent unauthorized manipulation of set-up and control parameters, as detailed in the control system programming section, and as deemed

appropriate by the owner. This shall include additional features as dictated by equipment and control operations.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1. Product data for each type of product specified.
2. Shop drawings detailing control system including, but not limited to the following:

   a. Document of proposed system programming logic tree, showing integrated control of all specified equipment, as well as the type of control signal planned for each type of equipment.
   b. Paper document of proposed touch panel programming showing scaled, color printout's of all touch panel pages which identify button colors, configurations, icons, graphics, and text.
   c. Rack elevations showing component configuration inside equipment racks.
   d. Proposed modular control card for A/V or lighting system component to be controlled.

3. Wiring Diagrams detailing wiring for power, signal, and control differentiating clearly between manufacturer-installed wiring and field-installed wiring. Identify terminal numbers and wiring color codes to facilitate installation, operation, and maintenance.
4. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 13 Section "Basic A/V System Requirements." Provide complete operations and maintenance manual material concurrently with system submittal and provide updated final versions of manuals one month before completion of construction and final system turnover. Include the following:

   a. Equipment list showing quantity, make, model, and serial number.
   b. System operating instructions.
   c. System maintenance instructions.

5. Wiring codes for all system cable. (See "labeling", this section).
6. Proposed labeling for system components. (See "labeling", this section).
7. All special submittal instructions indicated on supplied design drawings.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of control system, components and accessories, of types, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience of A/V system projects similar to that required for this project. In addition, installers must have successfully completed a minimum of 3 similar installations over a period of 2 years prior to the date of the bid opening for this project. System installations must have included similar control system hardware and software. To qualify as similar, control systems must have included touch panel(s), central processing unit(s), and custom programming for touch panel pages. All custom programming code writing must have been written and de-bugged by a factory trained and certified programmer of the specified control system manufacturer who has successfully completed all relevant training courses recommended by the control system manufacturer for proficiency in system programming. In addition, the certified programmer must have been, and now be, a direct employee of the installer, in a permanent office staffed with factory qualified technicians, working for a minimum of 40 hours per week as a direct employee of the installer. The certified programmer and factory trained installers must be the direct employees of the installer; sub-contracted, third party maintenance agreements, or similar arrangements are expressly prohibited, and do not qualify. Upon request, submit evidence of such qualifications to the A/V Consultant. All of the above requirements must be complied with prior to the bid opening for this project.

C. Electrical Component Standard: Provide work complying with applicable requirements of NFPA 70 "National Electrical Code."

D. Codes and Standards: Comply with the following Codes and Standards:

1. Racks, Panels, and Associated Equipment, EIA-310-A.
2. NESC Compliance: Comply with National Electrical Safety Code requirements.
3. FCC Compliance: Comply with Subpart J of PART 15, FCC Rules pertaining to computing devices including Class A, Class B, personal and peripheral types. Provide equipment which complies with technical standards for both radiated and power line conducted interference.
4. UL Compliance: Comply with applicable requirements of UL Standards 486A and B, 813, 983, 1409, 1410, 1412, 1414, 1416, 1417, and 1418 pertaining to control system products. Provide control system and components which are UL-listed and labeled.
5. All installation practices shall be in accordance with, but not limited to, these specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of the Uniform Building Code, the National Electrical Code and all local authorities having jurisdiction. All installation work shall follow "standard broadcast wiring" and installation practices, as excerpted from "Recommended Wiring Practices," Sound System Engineering, (2nd Edition), D. Davis, and performed to the highest standards of acknowledged industry practices.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in factory containers. Store in clean, dry space in original containers. Protect products from fumes and construction traffic. Handle carefully to avoid damage.

1.7 WARRANTY REQUIREMENTS

A. Control system shall be subject to warranty requirements as stated in Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by those manufacturers identified in the equipment list.

2.2 SYSTEM REQUIREMENTS

A. General: Provide a complete and fully functional control system using materials and equipment of types, sizes, ratings, and performances as identified in the equipment list. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction in accordance with published product information. Coordinate the features of materials and equipment so they form an integrated system with components and interconnections matched for optimum performance of specified functions.

B. The control system programming outline, as defined in these specifications, constitutes the minimum control system requirements for adequate control of the A/V and lighting systems. The programming outline is a guideline only, provided for the sole purpose of demonstrating intent. It is likely that touch panel/control system buttons, pages, and/or programming will be required which are not identified in the programming outline. During the final software programming, the installer shall work in a close and cooperative manner with the A/V consultant and Owner's representative, to make additional modifications, and/or changes in programming procedural events, changes in touch panel functions, and changes in programming features as needed at no additional cost to the owner. These adjustments to the system programming outline in this section shall include, but not be limited to, changes in the system programming code, page layouts, equipment operating modes, and system logic from the parameters outlined here to ensure the flexible and user friendly

operation of the A/V system. Include all costs necessary to make moderate changes to the control system programming code and touch panel buttons and pages in the base bid.

C. The final program shall have sufficient "remark statements" at various points in the program to enable easy identification of blocks of programming code.

D. The Installer shall include a complete functioning code for the lighting system via control from both the touch panel pages as well as from the wall mounted lighting control panel as described.

E. Upon completion of system installation, a complete set of backup source code programs for the touch panels and mainframe technology of each room shall be provided on CD to the owner's representative.

2.3 EQUIPMENT AND MATERIALS

A. General: Provide equipment selected from equipment list on drawings, using all solid-state components fully rated for continuous duty at the ratings indicated or specified. Select equipment for normal operation on input power supplied at 105-130 V, 60 Hz.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with requirements and other conditions affecting the performance of the control system work.

B. Do not proceed until unsatisfactory conditions have been corrected.

C. Verify compliance of following items before beginning control equipment installation.

1. No cables spliced except at standard barrier terminal blocks or approved method inside equipment racks.
2. Cables marked at each end with permanent wire labels such as Brady or equal.
3. Specified conduit, cables, enclosures and equipment cabinets are properly installed.
4. Location and angle of loudspeaker cabinets.
5. Location and stability of projection system mounting supports.

3.2 INSTALLATION

A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.

B. All programming a page layouts shall comply with current UVU standards and procedures. The outline below is provided for assistance, but does not supersede campus standards. Verify all programming with UVU Media Engineering.

C. System Programming and Programming Outline: Provide complete control system programming services including but not limited to the creation of custom software required to meet all contract document requirements including but not limited to the programming outline specified below. Include manufacturer direct services and on site support. Please note that not all equipment, functions, and/or controls may not be specified or required for all rooms. Program software based on the following programming outline as applicable to individual single line diagrams identified in the accompanying drawings.

1. GENERAL PROGRAMMING REQUIREMENTS: The following programming outline contains control system programming requirements. In addition to these requirements, these specifications mandate the use of previously written code blocks, and system functionality descriptions prepared by the control system manufacturer. For example, without implying

limitation, the functionality for the annotation system component of the audio and video systems shall include similar functionality to that represented by the programming module example hosted in the "Design Center - Integration" section at www.crestron.com. This example is typical of many other control system requirements found herein.

2. CAMPUS STANDARDS: The Owner will provide example touch panel layout configurations, a color pallet, and color scheme for all touch panel pages. The work of this project will require the control system programmer to match existing campus touch panel buttons, capabilities, and features. Specific button names and logic specified in the Programming Outline, or lack thereof, do not alleviate the requirement for the control system programmer to comply with and follow existing campus touch panel configurations, control system capabilities, and control system code standards.

3. SYSTEM ACTIVATION: When the A/V system has been deactivated by the system off button, or when the touch panel has entered its "time out" mode, display the following message on the touch screen: "TOUCH SCREEN TO ACTIVATE". This message will remain constantly on, and shift positions if recommended by the manufacturer to prevent burn in.

4. INDIVIDUAL SYSTEM SHUTDOWN: Regardless of the time of day, the control system CPU in each individual classroom shall monitor system usage. If a control command has not been issued within a user adjustable period of time, a pop up window will ask “Do you want the A/V system to remain on?” with a “yes” button. If the yes button is engaged within 30 seconds, the system will remain on. If the yes button is not engaged within 30 seconds, a system off command will be issued, and the A/V system will proceed through orderly shut down. In addition, the control system in each classroom will automatically issue an off command each day at a user adjustable time of day.

5. BUTTON HIGHLIGHTING: When any button is engaged on any touch panel control page, that button shall be highlighted for the duration of physical contact between the finger and touch screen. In addition, when a any system function is activated/selected, the button will remain highlighted to identify the active status of the control system. In addition, comply with additional button highlighting requirements stated in the programming outline.

6. ICONS: The programming outline is a written description of buttons, pages, and commands. Even though the buttons are described with words, it is required that the installer make a reasonable use of icons when programming the touch panel pages.

7. PAGE FLIPS AND POP UP WINDOWS: Page flips and pop up windows are specified throughout the programming outline. If, at a specific location in the touch panel pages, the programmer believes one is more appropriate than the other, the programmer is encouraged to consult with the AV designer. Where pop up windows are used, program automatic time outs so that the pop up window will be automatically removed from the screen after a user adjustable period of time.

8. HELP BUTTONS: Where specified, help buttons will be provided on touch panel pages. All help buttons will be a question mark within a diamond. Selecting will bring up a help screen for the page in question only. The installer shall provide and customize as required, clear, concise, brief text which helps the operator to understand the button choices and their actions on the applicable page. The language for these help page messages shall be approved by the A/V Consultant and the Owners representative prior to programming. A RETURN button shall be provided on the help page to bring the operator back to the page in question.

9. LECTERN TOUCH PANEL: The lectern touch panel will serve as the AV system control panel, the lectern monitor, and the annotation input device (in rooms where annotation systems are specified). The specified touch panel will also serve as the video preview monitor in rooms where rear wall mounted cameras are specified. The active portion of the touch panel used for monitoring purposes will be consistently located on all touch panel

pages. All controls required for moving the monitor image, re-sizing the monitor image, minimizing (go partial screen) the monitor image, and maximizing (go full screen) the monitor image will be provided.

10. SPECIALTY ROOM AND EQUIPMENT REQUIREMENTS: The control system Programming Outline is a general guideline instruction set provided for bidders and programmers to assist with defining overall project requirements. The Programming Outline does not attempt to identify page by page and button by button descriptions of all specialty rooms and equipment. Where equipment is specified unique to specific rooms, refer to Control System Single Line Diagrams for confirmation of requirements for individual equipment item control. Where required, provide control of the identified items in the same manner that control is provided using that item's own user interface. Control all items identified in the Control System Single Line Diagrams regardless of if those equipment items are included in the Programming Outline.

11. GREETING PAGE: Upon first touching the screen a GREETING PAGE shall be displayed. This page will contain the OWNER'S LOGO, a welcome message, the DATE, the TIME, have the SYSTEM ON button, a HELP button (question mark within a diamond) and a LIGHTS button.

    a. BUTTON - SYSTEM ON: Selecting brings a 10 key numeric pad to the display for password entry to operate the A/V system. The password entry page shall also be equipped with a return button, to return the user to the greeting page. Use of the sytem shall be verified via UVU-ID Authentification baner data vase.. If entered correctly, bring up a START PAGE containing all common button bars. In addition, turn on the power controllers for all applicable A/V equipment with a 3 second delay between them. The last power controller circuit turned on shall be the audio amplifiers. In addition, all A/V applicable system parameters shall be set to default values. As an example only, without implying limitation, all volume levels shall be set to default values; the audio and video mutes shall be disengaged if previously left on; etc.... An incorrect password shall return the display back to the GREETING PAGE with no action taken.

12. COMMON BUTTON BARS: With the exception of the greeting page, all control system touch panel pages will contain all "common button bars" for the purpose of allowing access to fundamental control functions from any location in the touch panel page/software program. When a button in the common button bar group is selected, that button shall become highlighted, and remain highlighted until interaction with the corresponding page is terminated. At a minimum, without implying limitation, the common button bars shall contain the following:

    a. COMMON BUTTON BAR 1, GENERAL, (top center):

        1) BUTTON - SOURCE SELECT: Selecting brings up the source selection page.
        2) BUTTON - CONFERENCING (if applicable): Selecting brings up the conferencing select page.
        3) BUTTON - PROJECTOR/SCREEN: Selecting brings up the projector/screen control page.
        4) BUTTON – CURRENT STATUS: Selecting displays the current status of the AV system. Items to be identified include, but are not limited to: Power to individual system components, projector standby, system muting, audio levels, lighting levels, input currently selected.
        5) BUTTON - DISPLAY MODIFY (for rooms where multiple display devices serve a single physical space): Selecting brings up the display modify page.
        6) BUTTON - WINDOW COVERINGS (if applicable): Selecting brings up the motorized window coverings control page.
        7) BUTTON - SYSTEM OFF: Selecting shall display a text prompt asking "Are you sure?" with a text message stating that a certain period of time must elapse (time to be determined by the projector manufacturer) before the system can

be powered on again; in addition, provide buttons YES, and NO. IF YES, the system shall power off the AC power controllers in reverse order of turn on, turning the audio amplifiers off first, followed, three (3) seconds later, by the rest of the designated A/V equipment. If NO, the system shall return the touch panel back to the previous page with no action taken.

8) BUTTON - HELP: Provide as specified above.
9) BUTTON - TECHNICIAN SET UP: (Hidden button, no border). Selecting brings a 10 key numeric pad to the display for password entry to technician set-up pages. The password shall not be more than four (4) digits. This password shall be user programmable, and accessible through a technician set up page. If entered correctly, operator will be allowed access to the technician set up pages.
10) DISPLAY - DATE: Will display the correct date.
11) DISPLAY - TIME: Will display the correct time of day.

b. COMMON BUTTON BAR 2, LIGHTING, (left):

1) BUTTON - FULL, (100%): Selecting shall cause selected room lighting to fade to programmed presets in 3 seconds.
2) BUTTON - MEETING: Selecting shall cause selected room lighting to fade to programmed presets in 3 seconds.
3) BUTTON - VIDEO CONFERENCE (for rooms with video conferencing only): Selecting shall cause selected room lighting to fade to programmed presets in 3 seconds.
4) BUTTON - PROJECTION: Selecting shall cause selected room lighting to fade to programmed presets in 3 seconds.
5) BUTTON - ROOM LIGHTS INCREASE: Selecting shall increase scene lighting levels. Minimum and maximum levels shall be programmed into the dimming system. Button shall operate incrementally and continuously. When selected incrementally, the room light levels shall increase incrementally within the preprogrammed minimum and maximum parameters. When touched continuously, the light levels shall increase continuously within the preprogrammed minimum and maximum parameters.
6) BUTTON - ROOM LIGHTS DECREASE: Selecting shall decrease scene lighting levels. Minimum and maximum levels shall be programmed into the dimming system. Button shall operate incrementally and continuously. When selected incrementally, the room light levels shall decrease incrementally within the preprogrammed minimum and maximum parameters. When touched continuously, the light levels shall decrease continuously within the preprogrammed minimum and maximum parameters.
7) BUTTON - OFF: Selecting shall cause selected room lighting to fade to off in 3 seconds.
8) BUTTON - HELP: Provide as specified above.

c. COMMON BUTTON BAR, MISCELLANEOUS (bottom left):

1) BUTTON - BACK: Selecting shall return the user to the previous page selected, similar to a common web browser. This function shall be provided on every touch panel page except for the GREETING PAGE and START PAGE.

d. COMMON BUTTON BAR 3, VOLUME CONTROL, (right):

1) BUTTON - MICROPHONE VOLUME UP: Selecting shall simultaneously increase the input levels of all microphone inputs to the mixer. All mixer levels will change independently, without changing relative levels between microphone inputs. Minimum and maximum levels shall be programmed into the volume control which shall prevent complete inaudibility and/or feedback. Button shall operate incrementally and continuously. When selected incrementally, the volume shall increase incrementally within the

preprogrammed minimum and maximum parameters. When touched continuously, the volume shall increase continuously within the preprogrammed minimum and maximum parameters. If microphones were muted prior to selection, disengage the mute function, display the bar graph, and engage the volume up control.

2) BUTTON - MICROPHONE VOLUME DOWN: Selecting shall simultaneously decrease the input levels of all microphone inputs to the mixer. All mixer levels will change independently, without changing relative levels between microphone inputs. Minimum and maximum levels shall be programmed into the volume control which shall prevent complete inaudibility and/or feedback. Button shall operate incrementally and continuously. When selected incrementally, the volume shall decrease incrementally within the preprogrammed minimum and maximum parameters. When touched continuously, the volume shall decrease continuously within the preprogrammed minimum and maximum parameters. If microphones were muted prior to selection, disengage the mute function, display the bar graph, and engage the volume down control.

3) DISPLAY - MICROPHONE VOLUME UP AND DOWN BAR GRAPH: Bar graph shall be continuously displayed adjacent to volume up and down buttons. Bar graph shall graphically display the window between the preprogrammed minimum and maximum volume settings. The bar graph shall be divided into a minimum of 10 segments which shall incrementally or continuously appear or disappear according to the volume button selected. The bar graph display shall be removed from the screen when the mute function is selected. The bar graph shall be restored to its previous setting when the mute function is toggled off.

4) BUTTON - MICROPHONE MUTE (toggle function): Selecting shall highlight and flash the button, and simultaneously mute all microphone inputs to the mixer. Mute shall be defined as a minimum 60 dBA decrease in sound pressure level. Bar graph display shall be removed. Selecting again will simultaneously un-mute all microphone inputs to the mixer, and the bar graph display will be restored showing its previous setting.

5) BUTTON - STUDENT MICROPHONE MUTE (toggle function) (where applicable): Selecting shall highlight and flash the button, and simultaneously mute all student microphone inputs to the mixer. Mute shall be defined as a minimum 60 dBA decrease in sound pressure level. Bar graph display shall be removed. Selecting again will simultaneously un-mute the student microphone inputs to the mixer, and the bar graph display will be restored showing its previous setting.

6) BUTTON - MEDIA SOURCE VOLUME UP: Selecting shall simultaneously increase the input levels of all media source inputs to the mixer. All mixer levels will change independently, without changing relative levels between microphone inputs. Minimum and maximum levels shall be programmed into the volume control which shall prevent complete inaudibility and/or feedback. Button shall operate incrementally and continuously. When selected incrementally, the volume shall increase incrementally within the preprogrammed minimum and maximum parameters. When touched continuously, the volume shall increase continuously within the preprogrammed minimum and maximum parameters. If the media source mixer inputs were muted prior to selection, disengage the mute function, display the bar graph, and engage the volume up control.

7) BUTTON - MEDIA SOURCE VOLUME DOWN: Selecting shall simultaneously decrease the input levels of all media source inputs to the mixer. All mixer

levels will change independently, without changing relative levels between microphone inputs. Minimum and maximum levels shall be programmed into the volume control which shall prevent complete inaudibility and/or feedback. Button shall operate incrementally and continuously. When selected incrementally, the volume shall decrease incrementally within the preprogrammed minimum and maximum parameters. When touched continuously, the volume shall decrease continuously within the preprogrammed minimum and maximum parameters. If the media source mixer inputs were muted prior to selection, disengage the mute function, display the bar graph, and engage the volume down control.

8) DISPLAY - MEDIA SOURCE VOLUME UP AND DOWN BAR GRAPH: Bar graph shall be continuously displayed adjacent to volume up and down buttons. Bar graph shall graphically display the window between the preprogrammed minimum and maximum volume settings. The bar graph shall be divided into a minimum of 10 segments which shall incrementally or continuously appear or disappear according to the volume button selected. The bar graph display shall be removed from the screen when the mute function is selected. The bar graph shall be restored to its previous setting when the mute function is toggled off.

9) BUTTON - MEDIA SOURCE MUTE (Toggle function): Selecting shall highlight and flash the button, and simultaneously mute the media source inputs to the mixer. Mute shall be defined as a minimum 60 dBA decrease in sound pressure level. Bar graph display shall be removed. Selecting again will simultaneously un-mute the media source inputs to the mixer, and the bar graph display will be restored showing its previous setting.

10) BUTTON - PLATFORM SPEAKERS VOLUME UP: Selecting shall increase the level of the mixer output which feeds the platform speaker amplifier. Button shall operate incrementally and continuously. When selected incrementally, the volume shall increase incrementally within the preprogrammed minimum and maximum parameters. When touched continuously, the volume shall increase continuously within the preprogrammed minimum and maximum parameters. If the platform speakers were muted prior to selection, disengage the mute function, display the bar graph, and engage the volume up control.

11) BUTTON - PLATFORM SPEAKERS VOLUME DOWN: Selecting shall decrease the level of the mixer output which feeds the platform speaker amplifier. Button shall operate incrementally and continuously. When selected incrementally, the volume shall decrease incrementally within the preprogrammed minimum and maximum parameters. When touched continuously, the volume shall decrease continuously within the preprogrammed minimum and maximum parameters. If the platform speakers were muted prior to selection, disengage the mute function, display the bar graph, and engage the volume down control.

12) DISPLAY - PLATFORM SPEAKERS VOLUME UP AND DOWN BAR GRAPH: Bar graph shall be continuously displayed adjacent to volume up and down buttons. Bar graph shall graphically display the window between the preprogrammed minimum and maximum volume settings. The bar graph shall be divided into a minimum of 10 segments which shall incrementally or continuously appear or disappear according to the volume button selected. The bar graph display shall be removed from the screen when the mute function is selected. The bar graph shall be restored to its previous setting when the mute function is toggled off.

13) BUTTON - PLATFORM SPEAKERS MUTE (Toggle function): Selecting shall highlight and flash the button, and mute the mixer output which feeds the

platform speaker amplifier. Mute shall be defined as a minimum 60 dBA decrease in sound pressure level. Bar graph display shall be removed. Selecting again will un-mute the mixer output which feeds the platform speaker amplifier, and the bar graph display will be restored showing its previous setting.

14) BUTTON - FAR END AUDIO VOLUME UP (required where teleconferencing/video conferencing capability is specified).: Selecting shall increase the conferencing far end audio input to the mixer. Minimum and maximum levels shall be programmed into the volume control which shall prevent complete inaudibility and/or feedback. Button shall operate incrementally and continuously. When selected incrementally, the volume shall increase incrementally within the preprogrammed minimum and maximum parameters. When touched continuously, the volume shall increase continuously within the preprogrammed minimum and maximum parameters. If the far end audio was muted prior to selection, disengage the mute function, display the bar graph, and engage the volume up control.

15) BUTTON - FAR END AUDIO VOLUME DOWN (required where teleconferencing/video conferencing capability is specified). : Selecting shall decrease the conferencing far end audio input to the mixer. Minimum and maximum levels shall be programmed into the volume control which shall prevent complete inaudibility and/or feedback. Button shall operate incrementally and continuously. When selected incrementally, the volume shall decrease incrementally within the preprogrammed minimum and maximum parameters. When touched continuously, the volume shall decrease continuously within the preprogrammed minimum and maximum parameters. If the far end audio was muted prior to selection, disengage the mute function, display the bar graph, and engage the volume down control.

16) DISPLAY - FAR END AUDIO VOLUME UP AND DOWN BAR GRAPH: Bar graph shall be continuously displayed adjacent to volume up and down buttons. Bar graph shall graphically display the window between the preprogrammed minimum and maximum volume settings. The bar graph shall be divided into a minimum of 10 segments which shall incrementally or continuously appear or disappear according to the volume button selected. The bar graph display shall be removed from the screen when the mute function is selected. The bar graph shall be restored to its previous setting when the mute function is toggled off.

17) BUTTON - MICROPHONE MUTE (toggle function): Selecting shall highlight and flash the button, and mute far end audio input to the mixer. Mute shall be defined as a minimum 60 dBA decrease in sound pressure level. Bar graph display shall be removed. Selecting again will un-mute the far end audio input to the mixer, and the bar graph display will be restored showing its previous setting.

18) BUTTON - HELP: Provide one help button for all audio volume and mute controls as specified above.

e. COMMON BUTTON BAR 5, MISCELLANEOUS, (bottom right):

1) BUTTON - PROJECTOR STANDBY (toggle function): Selecting shall highlight and flash the button, stop the light output from the projector (video mute), and place the projector in standby. Selecting again shall “un-mute” the video projector light output and return the projector to normal operation. (Projector standby will not effect the podium monitor).

2) BUTTON - MAKE-A-POINT (toggle function), (Icon: hammer and a head): Selecting shall highlight and flash the button, place the projector in standby, pause the transport motor on any source device in use, and fade lighting to the meeting preset. Selecting again will take the projector out of standby, disengage the transport motor pause of any source device in use, and fade lighting to the projection preset.

3) BUTTON - ANNOTATION: Selecting will engage the annotation (Boeckeller Pointmaker) system capability. In addition, selecting will cause the monitor image to maximize, and will bring up an annotation system function control pop-up window.

4) BUTTON - HELP: Provide as specified above.

f. INFRA-RED SENSORS (if applicable): Infra-red sensors are specified to monitor the position of folding partition walls. Connect infra-red sensor signal outputs to control system voltage sensing cards:

1) AUDIO SYSTEMS: Upon sensing a closed partition, the audio matrix mixer will route audio signals to facilitate the use of fully functional, separate sound systems in all room sections simultaneously. The specified audio system will operate as completely separate, multiple systems including, but not limited to all automatic mixer functions, volume level change functions, and tele-conferencing functions fully operational in each room section. Upon sensing a closed partition, the audio matrix mixer will route audio signals to facilitate the use of a single, fully functional sound system in all combined room sections. The specified audio system will operate as a single system in all combined sections including, but not limited to all automatic mixer functions, volume level change functions, and tele-conferencing functions fully operational in each room section.

2) VIDEO SYSTEMS: Upon sensing a closed partition, the RGBHV matrix switcher will route video signals to facilitate the use of fully functional, separate video systems in all room sections simultaneously. The specified video systems will operate as completely separate, multiple systems including, but not limited to source selection and display of video signals in various formats. Upon sensing an open partition, the RGBHV matrix switcher will route video signals to facilitate the use of a single, fully functional video system in all combined room sections. The specified video system will operate as a single system in all combined sections including, but not limited to source selection and display of video signals in various formats.

3) LIGHTING SYSTEMS: Upon sensing a closed partition, the lighting systems will operate as fully functional, separate systems in all individual room sections simultaneously. The specified lighting systems will operate as completely separate, multiple systems including, but not limited to, preset changes, on/off commands, and dimmer level changes. Upon sensing an open partition, the lighting systems will operate as a single, fully functional, system in all combined room sections. The specified lighting system will operate as a single system including, but not limited to, preset changes, on/off commands, and dimmer level changes.

13. SOURCE SELECTION PAGE: (Use j-pegs of actual component photographs for source button icons).

a. BUTTON - DOCUMENT CAMERA: Selecting shall power up the applicable equipment (if not already on), set all applicable parameters to default values, and route the video signal through the switching technology to the appropriate display devices. In rooms where multiple display devices serve a single physical space, the

appropriate display devices will be selected utilizing a pop up graphic of the applicable room floor plan. The floor plan will show a button icon representing each display device at the appropriate location within the room graphic, and prompt: “PLEASE SELECT DESIRED DISPLAY DEVICES”. As display devices are selected, buttons will become and remain highlighted. In addition, provide an ENTER button to implement display device selection commands to the switching technology. In addition, lower motorized projection screens and projector lifts to the show position, (if applicable). In addition, selecting will adjust lighting levels to the projection preset. In addition, selecting will close all motorized window coverings (if applicable). In addition, selecting will bring up the document camera function control page.

b. BUTTON – DVD/VCR: Selecting shall power up the applicable equipment (if not already on), set all applicable parameters to default values, route the stereo audio and video through the switching technology and audio reinforcement system to the appropriate display devices and to the audio amplification system. In rooms where multiple display devices serve a single physical space, the appropriate display devices will be selected utilizing a pop up graphic of the applicable room floor plan. The floor plan will show a button icon representing each display device at the appropriate location within the room graphic, and prompt: “PLEASE SELECT DESIRED DISPLAY DEVICES”. As display devices are selected, buttons will become and remain highlighted. In addition, provide an ENTER button to implement display device selection commands to the switching technology. In addition, lower motorized projection screens and projector lifts to the show position, (if applicable). In addition, selecting will adjust lighting levels to the projection preset. In addition, selecting will close all motorized window coverings (if applicable). In addition, selecting will bring up the VCR function control page.

c. BUTTON - TUNER: Selecting shall power up the applicable equipment (if not already on), set all applicable parameters to default values, route the stereo audio and video through the switching technology and audio reinforcement system to the appropriate display devices and to the audio amplification system. In rooms where multiple display devices serve a single physical space, the appropriate display devices will be selected utilizing a pop up graphic of the applicable room floor plan. The floor plan will show a button icon representing each display device at the appropriate location within the room graphic, and prompt: “PLEASE SELECT DESIRED DISPLAY DEVICES”. As display devices are selected, buttons will become and remain highlighted. In addition, provide an ENTER button to implement display device selection commands to the switching technology. In addition, lower motorized projection screens and projector lifts to the show position, (if applicable). In addition, selecting will adjust lighting levels to the projection preset. In addition, selecting will close all motorized window coverings (if applicable). In addition, selecting will bring up the tuner function control page.

d. BUTTON - DVD: Selecting shall power up the applicable equipment (if not already on), set all applicable parameters to default values, route the stereo audio and video through the switching technology and audio reinforcement system to the appropriate display devices and to the audio amplification system. In rooms where multiple display devices serve a single physical space, the appropriate display devices will be selected utilizing a pop up graphic of the applicable room floor plan. The floor plan will show a button icon representing each display device at the appropriate location within the room graphic, and prompt: “PLEASE SELECT DESIRED DISPLAY DEVICES”. As display devices are selected, buttons will become and remain highlighted. In addition, provide an ENTER button to implement display device selection commands to the switching technology. In addition, lower motorized projection screens and projector lifts to the show position, (if applicable). In addition, selecting will adjust lighting levels to the projection preset. In addition, selecting will close all motorized window coverings (if applicable). In addition, selecting will bring up the VCR function control page.

e. BUTTON - COMPUTER INPUT (TYPICAL): Selecting shall power up the applicable equipment (if not already on), route the stereo audio and analog RGB video through the switching technology and audio reinforcement system to the appropriate display devices and to the audio amplification system. In rooms where multiple display devices serve a single physical space, the appropriate display devices will be selected utilizing a pop up graphic of the applicable room floor plan. The floor plan will show a button icon representing each display device at the appropriate location within the room graphic, and prompt: “PLEASE SELECT DESIRED DISPLAY DEVICES”. As display devices are selected, buttons will become and remain highlighted. In addition, provide an ENTER button to implement display device selection commands to the switching technology. In addition, lower motorized projection screens and projector lifts to the show position, (if applicable). In addition, selecting will adjust lighting levels to the projection preset. In addition, selecting will close all motorized window coverings (if applicable). In addition, selecting will bring up the computer input function control page.

f. BUTTON - VIDEO INPUT (TYPICAL OF YC AND COMPOSITE WHERE APPLICABLE): Selecting shall power up the applicable equipment (if not already on), route the stereo audio and video through the switching technology and audio reinforcement system to the appropriate display devices and to the audio amplification system. In rooms where multiple display devices serve a single physical space, the appropriate display devices will be selected utilizing a pop up graphic of the applicable room floor plan. The floor plan will show a button icon representing each display device at the appropriate location within the room graphic, and prompt: “PLEASE SELECT DESIRED DISPLAY DEVICES”. As display devices are selected, buttons will become and remain highlighted. In addition, provide an ENTER button to implement display device selection commands to the switching technology. In addition, lower motorized projection screens and projector lifts to the show position, (if applicable). In addition, selecting will adjust lighting levels to the projection preset. In addition, selecting will close all motorized window coverings (if applicable). In addition, selecting will bring up the video input function control page.

g. BUTTON - HELP: Provide as specified above.

14. CONFERENCING SELECT PAGE:

a. BUTTON - VIDEO CONFERENCE (if applicable): Selecting shall power up the applicable equipment (if not already on), set all applicable parameters to default values, route the CODEC audio and video through the through the switching technology and audio reinforcement system to the appropriate display devices and to the audio amplification system. The appropriate display devices will be selected utilizing a pop up graphic of the applicable room floor plan. The floor plan will show a button icon representing each display device at the appropriate location within the room graphic, and prompt: “PLEASE SELECT DESIRED DISPLAY DEVICES”. As display devices are selected, buttons will become and remain highlighted. In addition, provide an ENTER button to implement display device selection commands to the switching technology. In addition, selecting will adjust lighting levels to the video conferencing preset. In addition, selecting will close all motorized window coverings (if applicable). In addition, selecting will bring up the video conferencing function control page.

b. BUTTON - TELE-CONFERENCE (if applicable): Selecting shall power up the applicable equipment (if not already on), and set all applicable mixer and telephone interface parameters to default values. In addition, selecting will bring up the teleconference function control page.

c. BUTTON - HELP: Provide as specified above.

15. PROJECTOR/SCREEN CONTROL PAGE:

a. BUTTON - PROJECTION ENVIRONMENT: Selecting shall power on the projector(s), close window coverings (if applicable) and fade all lighting to the “projection” preset. In addition, cause a brief text message to be displayed recommending a 5 minute warm up time for quality display of computer data images. In addition, the projector shall reset to preprogrammed default settings.

b. BUTTON - MEETING ENVIRONMENT (typical): Selecting shall display a text prompt asking "Are you sure, approximately (insert time recommended by the manufacturer) minutes must elapse prior to powering up the projector again?" with buttons YES, and NO. IF YES, the system shall power off the projector in accordance to the shut down procedure recommended by the manufacturer. In addition the projection screen shall be raised to the “store” position, and the room lighting shall fade to the “full” preset. IF NO, the system shall return the touch panel back to the previous page with no action taken.

c. BUTTON - PROJECTOR ON (typical): Selecting shall power on the projector, and cause a brief text message to be displayed recommending a 10 minute warm up time for quality display of computer data images. In addition, the projector shall reset to preprogrammed default settings.

d. BUTTON - PROJECTOR OFF (typical): Selecting shall display a text prompt asking "Are you sure, approximately (insert time recommended by the manufacturer) minutes must elapse prior to powering up the projector again?" with buttons YES, and NO. IF YES, the system shall power off the projector in accordance to the shut down procedure recommended by the manufacturer. IF NO, the system shall return the touch panel back to the previous page with no action taken.

e. BUTTON - PROJECTOR STANDBY (Toggle function) (typical): Selecting shall highlight and flash the button, and place the video projector in stand by. Selecting again will take the projector out of stand by.

f. BUTTON - PROJECTOR DEFAULT SETTINGS: Selecting shall reset all the projector's applicable adjustments to a preprogrammed default settings (i.e. Brightness, contrast, color, hue, etc.)

g. BUTTON - FRONT PROJECTION SCREEN LOWER (typical): Selecting shall cause the projection screen to lower to its “show” position.

h. BUTTON - FRONT PROJECTION SCREEN RAISE (typical): Selecting shall cause the projection screen to raise to its “store” position.

i. BUTTON - FRONT PROJECTION SCREEN STOP (typical): Selecting shall cause the projection screen motion to stop.

j. BUTTON - PROJECTOR LIFT, STORE POSITION (if applicable) (typical): Selecting shall highlight button and raise projector lift into the finished ceiling for storage.

k. BUTTON - PROJECTOR LIFT, SHOW POSITION (if applicable) (typical): Selecting shall highlight button and lower projector lift to the show position.

l. BUTTON - HELP: Provide as specified above.

16. DISPLAY MODIFY PAGE: Provide a room graphic of the applicable room floor plan. The floor plan will show a button icon representing each display device at the appropriate location within the room graphic. In addition, include a HELP button as specified above. Selecting a button shall bring up a pop up window with the following buttons:

a. BUTTON - ON: Turns the selected display device on (if not already on).

b. BUTTON - OFF: Turns the selected display device off (if not already off).

c. BUTTON - STANDBY (For the projectors only) (Toggle function): Selecting places the projector in standby. Selecting again takes the projector out of standby.

d. BUTTON - CLEAR: Clears all control commands issued to modify the source selection to the selected display device. Relinquish source selection control to the standard source selection specified above.

e. BUTTONS - AVAILABLE SOURCES: Provide one button icon for each available source device. Once a source device is selected, command the switching technology to route the selected source to the selected display device and remove the pop up window from the screen.

f. BUTTON - HELP: Provide as specified above.

17. WINDOW COVERING CONTROL PAGE (IF APPLICABLE):

a. BUTTON - WINDOW COVERINGS CLOSE: Selecting shall cause all window coverings at the designated location to close.

b. BUTTON - WINDOW COVERINGS OPEN: Selecting shall cause all window coverings at the designated location to open.

c. BUTTON - WINDOW COVERINGS STOP: Selecting shall cause all window coverings at the designated location to stop.

18. FUNCTION CONTROL PAGES:

a. DOCUMENT CAMERA FUNCTION CONTROL PAGE (applicable in rooms only where document cameras are installed at a single location, and are not portable):

1) BUTTONS: Provide all buttons necessary to control all functions of the selected device/system. As a general rule, without implying limitation, provide control buttons on touch panel function control pages which duplicate the control buttons provided on or in the device/system control panel, remote controller, and/or control software. Where sensible, configure and label buttons on touch panel function control pages in the same way system/device control buttons are configured and labeled on their own control panels, remote controllers, and/or control software.

2) BUTTON - NEW SOURCE: Selecting shall highlight button and discontinue all transport functions (if any) associated with the function control page. In addition, selecting shall bring up the SOURCE SELECT PAGE without turning off display devices (if applicable), systems and/or devices; raising the projection screen(s)/lift(s) (if applicable); opening window coverings (if applicable), or changing lighting levels (if applicable).

3) BUTTON - EXIT: Selecting shall highlight button and display a text prompt asking "Are you sure?" with buttons YES, and NO. If YES is selected, discontinue all transport functions (if any) associated with the function control page, and place the projector in standby (if applicable). In addition the projection screen(s)/lift(s) shall be raised to the “store” position, and the room lighting shall fade to the “full” preset. In addition, selecting shall return the user to the START PAGE. If NO, the system shall return the touch panel back to the previous page with no action taken.

4) BUTTON - HELP: Provide as specified above.

b. DVD/VCR FUNCTION CONTROL PAGE:

1) BUTTONS: Provide all buttons necessary to control all functions of the selected device/system. As a general rule, without implying limitation, provide control buttons on touch panel function control pages which duplicate the control buttons provided on or in the device/system control panel, remote controller, and/or control software. Where sensible, configure and label buttons on touch panel function control pages in the same way system/device control buttons are configured and labeled on their own control panels, remote controllers, and/or control software.

2) BUTTON - NEW SOURCE: Selecting shall highlight button and discontinue all transport functions (if any) associated with the function control page. In addition, selecting shall bring up the SOURCE SELECT PAGE without turning off display devices (if applicable), systems and/or devices; raising the projection screen(s)/lift(s) (if applicable); opening window coverings (if applicable), or changing lighting levels (if applicable).

3) BUTTON - EXIT: Selecting shall highlight button and display a text prompt asking "Are you sure?" with buttons YES, and NO. If YES is selected, discontinue all transport functions (if any) associated with the function control page, and place the projector in standby (if applicable). In addition the projection screen(s)/lift(s) shall be raised to the “store” position, and the room lighting shall fade to the “full” preset. In addition, selecting shall return the user to the START PAGE. If NO, the system shall return the touch panel back to the previous page with no action taken.

4) BUTTON - HELP: Provide as specified above.

c. DVD FUNCTION CONTROL PAGE:

1) BUTTONS: Provide all buttons necessary to control all functions of the selected device/system. As a general rule, without implying limitation, provide control buttons on touch panel function control pages which duplicate the control buttons provided on or in the device/system control panel, remote controller, and/or control software. Where sensible, configure and label buttons on touch panel function control pages in the same way system/device control buttons are configured and labeled on their own control panels, remote controllers, and/or control software.

2) BUTTON - NEW SOURCE: Selecting shall highlight button and discontinue all transport functions (if any) associated with the function control page. In addition, selecting shall bring up the SOURCE SELECT PAGE without turning off display devices (if applicable), systems and/or devices; raising the projection screen(s)/lift(s) (if applicable); opening window coverings (if applicable), or changing lighting levels (if applicable).

3) BUTTON - EXIT: Selecting shall highlight button and display a text prompt asking "Are you sure?" with buttons YES, and NO. If YES is selected, discontinue all transport functions (if any) associated with the function control page, and place the projector in standby (if applicable). In addition the projection screen(s)/lift(s) shall be raised to the “store” position, and the room lighting shall fade to the “full” preset. In addition, selecting shall return the user to the START PAGE. If NO, the system shall return the touch panel back to the previous page with no action taken.

4) BUTTON - HELP: Provide as specified above.

d. COMPUTER INPUT FUNCTION CONTROL PAGE (TYPICAL):

1) TEXT MESSAGE: "You have selected computer input XX as an input source for display".

2) BUTTON - NEW SOURCE: Selecting shall highlight button and discontinue all transport functions (if any) associated with the function control page. In addition, selecting shall bring up the SOURCE SELECT PAGE without turning off display devices (if applicable), systems and/or devices; raising the projection screen(s)/lift(s) (if applicable); opening window coverings (if applicable), or changing lighting levels (if applicable).

3) BUTTON - EXIT: Selecting shall highlight button and display a text prompt asking "Are you sure?" with buttons YES, and NO. If YES is selected, discontinue all transport functions (if any) associated with the function control page, and place the projector in standby (if applicable). In addition the projection screen(s)/lift(s) shall be raised to the “store” position, and the room lighting shall fade to the “full” preset. In addition, selecting shall return the user to the START PAGE. If NO, the system shall return the touch panel back to the previous page with no action taken.

4) BUTTON - HELP: Provide as specified above.

e. VIDEO INPUT FUNCTION CONTROL PAGE (TYPICAL):

1) TEXT MESSAGE: "You have selected XX video input as an input source for display".

2) BUTTON - NEW SOURCE: Selecting shall highlight button and discontinue all transport functions (if any) associated with the function control page. In addition, selecting shall bring up the SOURCE SELECT PAGE without turning off display devices (if applicable), systems and/or devices; raising the projection screen(s)/lift(s) (if applicable); opening window coverings (if applicable), or changing lighting levels (if applicable).

3) BUTTON - EXIT: Selecting shall highlight button and display a text prompt asking "Are you sure?" with buttons YES, and NO. If YES is selected, discontinue all transport functions (if any) associated with the function control page, and place the projector in standby (if applicable). In addition the projection screen(s)/lift(s) shall be raised to the “store” position, and the room lighting shall fade to the “full” preset. In addition, selecting shall return the user to the START PAGE. If NO, the system shall return the touch panel back to the previous page with no action taken.

4) BUTTON - HELP: Provide as specified above.

f. TUNER FUNCTION CONTROL PAGE:

1) BUTTONS: Provide all buttons necessary to control all functions of the selected device/system. As a general rule, without implying limitation, provide control buttons on touch panel function control pages which duplicate the control buttons provided on or in the device/system control panel, remote controller, and/or control software. Where sensible, configure and label buttons on touch panel function control pages in the same way system/device control buttons are configured and labeled on their own control panels, remote controllers, and/or control software.

2) BUTTON - NEW SOURCE: Selecting shall highlight button and discontinue all transport functions (if any) associated with the function control page. In addition, selecting shall bring up the SOURCE SELECT PAGE without turning

off display devices (if applicable), systems and/or devices; raising the projection screen(s)/lift(s) (if applicable); opening window coverings (if applicable), or changing lighting levels (if applicable).

3) BUTTON - EXIT: Selecting shall highlight button and display a text prompt asking "Are you sure?" with buttons YES, and NO. If YES is selected, discontinue all transport functions (if any) associated with the function control page, and place the projector in standby (if applicable). In addition the projection screen(s)/lift(s) shall be raised to the “store” position, and the room lighting shall fade to the “full” preset. In addition, selecting shall return the user to the START PAGE. If NO, the system shall return the touch panel back to the previous page with no action taken.

4) BUTTON - HELP: Provide as specified above.

g. VIDEO CONFERENCE FUNCTION CONTROL PAGE:

1) BUTTONS: Provide all buttons necessary to control all functions of the selected device/system. As a general rule, without implying limitation, provide control buttons on touch panel function control pages which duplicate the control buttons provided on or in the device/system control panel, remote controller, and/or control software. Where sensible, configure and label buttons on touch panel function control pages in the same way system/device control buttons are configured and labeled on their own control panels, remote controllers, and/or control software.

2) BUTTON - NEW SOURCE: Selecting shall highlight button and discontinue all transport functions (if any) associated with the function control page. In addition, selecting shall bring up the SOURCE SELECT PAGE without turning off display devices (if applicable), systems and/or devices; raising the projection screen(s)/lift(s) (if applicable); opening window coverings (if applicable), or changing lighting levels (if applicable).

3) BUTTON - EXIT: Selecting shall highlight button and display a text prompt asking "Are you sure?" with buttons YES, and NO. If YES is selected, discontinue all transport functions (if any) associated with the function control page, and place the projector in standby (if applicable). In addition the projection screen(s)/lift(s) shall be raised to the “store” position, and the room lighting shall fade to the “full” preset. In addition, selecting shall return the user to the START PAGE. If NO, the system shall return the touch panel back to the previous page with no action taken.

4) BUTTON - HELP: Provide as specified above.

h. TELE-CONFERENCE FUNCTION CONTROL PAGE, (TYPICAL):

1) BUTTONS: Provide all buttons necessary to control all functions of the selected device/system. As a general rule, without implying limitation, provide control buttons on touch panel function control pages which duplicate the control buttons provided on or in the device/system control panel, remote controller, and/or control software. Where sensible, configure and label buttons on touch panel function control pages in the same way system/device control buttons are configured and labeled on their own control panels, remote controllers, and/or control software.

2) BUTTON - NEW SOURCE: Selecting shall highlight button and discontinue all transport functions (if any) associated with the function control page. In addition, selecting shall bring up the SOURCE SELECT PAGE without turning off display devices (if applicable), systems and/or devices; raising the

projection screen(s)/lift(s) (if applicable); opening window coverings (if applicable), or changing lighting levels (if applicable).

3) BUTTON - EXIT: Selecting shall highlight button and display a text prompt asking "Are you sure?" with buttons YES, and NO. If YES is selected, discontinue all transport functions (if any) associated with the function control page, and place the projector in standby (if applicable). In addition the projection screen(s)/lift(s) shall be raised to the “store” position, and the room lighting shall fade to the “full” preset. In addition, selecting shall return the user to the START PAGE. If NO, the system shall return the touch panel back to the previous page with no action taken.

4) BUTTON - HELP: Provide as specified above.

i. VIDEO CAMERA FUNCTION CONTROL PAGE:

1) BUTTONS: Provide all buttons necessary to control all functions of the selected device/system. As a general rule, without implying limitation, provide control buttons on touch panel function control pages which duplicate the control buttons provided on or in the device/system control panel, remote controller, and/or control software. Where sensible, configure and label buttons on touch panel function control pages in the same way system/device control buttons are configured and labeled on their own control panels, remote controllers, and/or control software.

2) BUTTON - NEW SOURCE: Selecting shall highlight button and discontinue all transport functions (if any) associated with the function control page. In addition, selecting shall bring up the SOURCE SELECT PAGE without turning off display devices (if applicable), systems and/or devices; raising the projection screen(s)/lift(s) (if applicable); opening window coverings (if applicable), or changing lighting levels (if applicable).

3) BUTTON - EXIT: Selecting shall highlight button and display a text prompt asking "Are you sure?" with buttons YES, and NO. If YES is selected, discontinue all transport functions (if any) associated with the function control page, and place the projector in standby (if applicable). In addition the projection screen(s)/lift(s) shall be raised to the “store” position, and the room lighting shall fade to the “full” preset. In addition, selecting shall return the user to the START PAGE. If NO, the system shall return the touch panel back to the previous page with no action taken.

4) BUTTON - HELP: Provide as specified above.

j. TECHNICIAN SET-UP PAGES: NOTE: Unlike all other control system pages, the technician set up pages are described in general terms. The intent is to provide the installer flexibility in page creation and software programming.

1) BUTTONS - PASSWORD PROGRAMMING: Provide required buttons to program and save four digit password(s) for access to the specified pages. Password to be comprised of any combination of numbers and/or letters.

2) BUTTONS - DATE AND TIME SET: Provide required buttons to set and enter the correct date, including day, month, and year. Provide required buttons to set and enter the correct time of day including hours and minutes.

3) BUTTONS - PROJECTOR LIFT (if applicable): Provide required buttons to lower the projector lift to a “service” position.

4) BUTTON - HELP: Provide as specified above.

END OF PROGRAMMING OUTLINE

k. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three times the weight of the equipment being installed. Any structural mounting that is not able to meet this requirement due to the specific nature of the equipment, manufacturer's requirements or limitations of the facility, shall not be installed without prior approval of the A/V consultant. Install all boxes, equipment, hardware, and other materials plumb, level, and square.

l. Install all technology equipment and support equipment in all podiums, and the other millwork in a neat and cosmetically dressed-out manner. All saw cuts, holes and recesses into laminates and woodwork shall be straight, all radius and circular cuts shall be consistent, and all uneven surfaces shall be corrected. This shall include the use of moldings, grommets, bushings, laminates, and wood products as required to dress out the installation of equipment. Assure that the installation of equipment and panels in the technology racks and podiums are completed by using matching screws, hardware and grommets.

D. Technology:

1. Assure sufficient ventilation for adequate cooling of equipment.
2. Install vent rack panels in unused spaces.
3. Securely fasten equipment plumb and square in place. Where equipment is installed in rack cabinets, utilize all fastening holes and cover open spaces with perforated panels.
4. Securely fasten relays and small components. Do not use sticky-back tape for fasteners.
5. Connect powered components to 120 VAC outlets on transient voltage surge suppressors. Do not connect to outlets on other components.
6. Leave sufficient service loops of uniform length on cables to allow operation of system with chassis outside cabinet.
7. All equipment shall be held firmly in place with proper types of mounting hardware as recommended and/or supplied by the manufacturer. All mounting hardware provided with equipment shall be used when practical. This shall include, but not be limited to, front and rear rack rails, angle brackets and rack mount kits. All equipment shall be installed so as to provide reasonable safety to the operator. The Lessor shall supply adequate ventilation for all enclosed equipment items which produce heat.

E. Cable, Wire, and Connectors:

1. All cable and wire shall be new and unspliced. Splicing of cables and conductors is expressly prohibited in any location other than the equipment racks.

2. Additional cable length shall be provided at all connector locations. Duplex box, junction box, and floor box locations shall be installed with sufficient cable length behind cover plates to permit wiring maintenance and connector replacement in the future.

3. When cable runs utilize the vertical cable raceways located within walls, the acoustic integrity of the walls shall be maintained. All cables that pass through cover plates of junction boxes and raceways, through slab-to-slab walls, and through conduit lines shall be properly gasketted and sealed and all acoustic material shall be restored or replaced.

4. Separation between system cables and all other services shall be maximized to prevent and/or minimize the potential for electro-magnetic interference (EMI). Particular care shall be taken to ensure at least a 12" separation from electrical lines whenever feasible. At points where separation is unavoidable, distribution cables shall cross other services at right angles whenever practical to minimize EMI.

5. Cables shall be installed in a manner that shall ensure no signal cables are placed on top of any lighting fixtures, ceiling speakers, HVAC controls or sensing devices, fire safety and sprinkler system detection technology, or any other technology or mechanical equipment.

6. No cables shall be laid directly on top of T-bar grid ceiling tiles. Support cables installed outside of conduit at a maximum of four foot intervals from the building structure. Do not utilize support wires from other trades or systems.

7. System cables shall be installed in a manner that will not block access to other equipment or services, across removable service panels and/or in any other manner to prohibit routine maintenance of HVAC system, fire safety equipment and building mechanical control system.

8. All exposed cable shall be dressed with heavy duty neoprene heat-shrink tubing.

9. All inter-rack cabling shall be neatly laced, dressed, strain relieved and adequately supported.

10. After completion of wiring and cable installation, all trough and box covers shall be notched out and grommeted for clearance of the various cable bundles, (i.e., separate audio, video, and control). These panel covers shall be screwed back in place and all gaskets shall be restored or replaced.

11. Do not place any wires and cables for this system in any conduit, raceway, wireway or cable tray that is used for the mechanical systems, electrical systems, or voice/data systems of the building.

12. Provide connectors of the type and quality as detailed in this contract, and/or as required to meet the minimum bandwidth requirements of the equipment to which the connectors are terminated. The overall quantity of connectors shall not be limited by the quantities indicated in the drawings and shall be provided as required.

13. No connectors shall be installed in non-accessible locations or used for splicing cables. All connectors shall be new.

14. All connectors shall incorporate strain relief mechanisms which firmly grip the jacket of connected cables. All connectors shall be properly polarized to prevent improper seating. Connectors shall provide appropriate electrical characteristics for the circuitry to which they are attached.

15. All inner-rack cables shall be grouped according to the signals being carried to reduce signal contamination. Separate groups shall be formed for the following:

    a. Power
    b. Control
    c. Video
    d. Audio cables carrying signals less than -20 dBM.
    e. Audio cables carrying signals between -20 dBM and +20 dBM.
    f. Audio cables carrying signals over +20 dBM.

16. Route all cable and wiring within equipment racks, cabinets and millwork according to function, separating wires of different signal levels (microphone, line level, amplifier output, AC, control, etc.) by as much distance as possible. Neatly arrange, harness and bundle all cable with nylon U/V rated ties.

17. As a general practice, all power cables, control cables, and high level cables shall be run on the left side of equipment racks as viewed from the rear. All other cables shall be run on the right side of all equipment racks as viewed from the rear.

18. All cables, except video cables which must be cut to an electrical length, shall be cut to the length dictated by the cable run.

19. Terminal blocks, boards, strips or connectors, shall be furnished by the installer for all cables which interface with racks, cabinets, consoles, or equipment modules. Affix terminal blocks, boards, strips or connectors to equipment racks using screws only. Double sided tape will not be accepted.

20. Comply with industry standard circuit polarity and loudspeaker wiring polarity. No cables shall be terminated with a polarity reversal between connectors at either end.

21. All system wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No bare wire ends shall be accepted.

22. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables including a separate tube for the ground or drain wire.

23. All solder connections shall be made with rosin-core solder. Temperature controlled soldering irons rated at least 60 watts shall be used for all soldering work

24. All mechanical connections shall be made with approved crimp lugs of the correct size and type for the connection. Wire nuts shall not be permitted. Each connector shall be attached with the proper size controlled-duty-cycle ratcheting crimp tool which has been approved by the manufacturer of the connectors.

25. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on the job site. The presence of such tools on the job site shall constitute evidence of mechanical connections made with unauthorized tools and shall provide sufficient grounds for rejection of all mechanical connections in the system, and the subsequent re-work of same.

26. Shields for audio cables shall be grounded at the input end only, of the various equipment items on the system to prevent potential for ground loops.

F. Identification and Labelling:

1. All cables, regardless of length, shall be marked with wrap-around number or letter cable markers at both ends. These labels shall be self laminating to ensure durability. The label format used shall be equal, or better than, the system detailed.

2. There shall be no unmarked cables any place in the system.

3. Marking codes used on cables shall correspond to codes provided with submittals, and/or the written documentation of the "as built" drawings.

4. All connectors, controls, equipment components, terminal blocks and equipment racks are to be permanently labeled in a format approved during the submittal process.

5. Clearly and permanently label all jacks, controls, connections, etc... Embossed or printed label tape shall not be used and is considered unacceptable for this system.

6. All labeling shall be completed prior to acceptance of the final system.

G. Repairs: Wherever walls, ceilings, floors, or other building finishes are cut for installation , repair, restore, and refinish to original appearance.

3.3 GROUNDING

A. Provide equipment grounding connections for audio system as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to eliminate ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

C. Provide one #10 ground conductor with green insulation between all equipment racks and the main electrical panel ground bus. Connect at each end.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Pretesting: Upon completing installation of the system, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new, and retest until materials satisfactory performance and conditions are achieved.

C. A/V Consultant Final Review:

1. Contractor shall assist A/V Consultant in reviewing the final system set up.
2. Coordinate final inspection schedule with A/V Consultant two weeks minimum prior to Consultant's final inspection.
3. Have copy of red-lined as-built documents available at time of inspection.
4. Have loose equipment (microphones, cables, etc) available at time of inspection.
5. Provide the following test equipment in good working order:
   a. Digital Volt-Ohmmeter.
6. Correct minor items so A/V Consultant may certify satisfactory completion during his visit.
7. Pay Consultant's additional fees and expenses if building or system have not been completed properly or sufficiently, requiring A/V Consultant to make subsequent visits to inspect, or certify completion.

3.5 COMMISSIONING

A. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. Comply with the requirements identified in Division 1, project closeout.

B. Train Owner's A/V system users in the procedures for control system operation and related media device operation. Provide a minimum of four hours training on two non-consecutive days.

C. Schedule training with Owner through the Architect, with at least 7 days advance notice.

D. Occupancy Adjustments: When requested by the Architect or the A/V Consultant within one year of date of substantial completion, provide on-site assistance in controls to suit actual occupied conditions, including but not limited to minor programming changes, and touch panel page reconfiguration. Provide up to eight visits to the site for this purpose at no additional cost to the owner.

3.6 CLEANING AND PROTECTION

A. Prior to final acceptance, clean system components and protect from damage and deterioration.

END OF SECTION 13138

SECTION 13741 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Comply with all requirements of UVU Master Specs

1.2 SUMMARY

A. Section Includes:
1. Pathways.
2. UTP cable.
3. 62.5/125-micrometer and 50/125-micrometer, multi-mode optical fiber cabling.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Cabling identification products.
6. Singlemode-optical fiber cabling

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. RCDD: Registered Communications Distribution Designer.

G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

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

B. Shop Drawings:
1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software. Verify all labeling with owner prior to submission.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics including the following:
   a. Cross-connects.
   b. Patch panels.
   c. Patch cords.
5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
   a. Vertical and horizontal offsets and transitions.
   b. Clearances for access above and to side of cable trays.
   c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
   d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

D. Source quality-control reports.

E. Field quality-control reports.

F. Maintenance Data: For splices and connectors to include in maintenance manuals.

G. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE
1. Installer Qualifications: Company specializing in the installation fiber optic Structured Wiring Systems with minimum 5 years documented experience. Contractor shall have a minimum of one person on job site at all times with documented formal training in the installation of fiber optic cabling systems. The contractor shall have on staff a Registered

Communication Distribution Designer (RCDD) as certified by Building Industry Consulting Services International (BICSI). Installer shall be Seimon CI certified.

B. Layout Responsibility: Preparation of Shop Drawings Cabling Administration Drawings, and field testing program development by an RCDD.
   1. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
   2. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Testing Agency Qualifications: An NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

D. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

G. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
   1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set
   2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
   3. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within **two** years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
   1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.12 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Patch-Panel Units: One of each type.
   2. Connecting Blocks: One of each type.

1.13 WARRANTY

A. The Contractor, hereby guarantees that all work is in accordance with all express and implied requirements of the Contract Documents, that all work is of good quality, and further warrants the work and material for a period of (1) year from date of substantial completion of the project, unless a longer period of time is specified in the Contract. All work not conforming to these requirements, may be considered defective.
   1. If, within one (1) year after substantial completion of the work, or within such longer period of time as may be prescribed by law or by the terms of any warranty in the Contract, any of the work is found to be defective or not in accordance with the Contract, the Contractor shall at its cost correct it promptly after receipt of a written notice from the Owner. The Contractor's obligation shall survive termination of the Contract. The Owner shall give such notice within a reasonable time after discovery of the condition.

B. The contractor warrants to the Owner that all materials and equipment furnished under this Contract shall be new unless otherwise specified, free from faults and defects and in conformance with the Contract Documents.
   1. Contractor shall secure manufacturer's warranties and deliver copies thereof to the Owner upon completion of the work. All such warranties shall commence from the date of substantial completion, and will not in any way reduce the Contractor's responsibilities under his Contract. Whenever guarantees or warranties are required by the specifications for a longer period than one year, such longer period shall govern.

C. Provide Siemon System Warranty

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cablofil Inc.
   b. Chatsworth CPI
   c. Cooper B-Line, Inc.
   d. GS Metals Corp.

2. Cable Tray Material: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than **0.000472 inches (0.012 mm)** thick hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than **0.002165 inches (0.055 mm)** thick.
   a. Basket Cable Trays: **width as shown on drawing** and **4 inches (200 mm)** deep. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
   b. Ladder Cable Trays: Nominally **18 inches (455 mm)** wide, and a rung spacing of **12 inches (305 mm)**.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels. Provide as shown on room layouts.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Mohawk
   2. General
   3. Siemon

B. Description: 100-ohm, 50-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket.
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with TIA/EIA-568-B.1 for performance specifications.
   3. Comply with TIA/EIA-568-B.2, Category 5e.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
      a. Communications, General Purpose: Type CM or CMG**;** CMP, CMR.
      b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
      c. Communications, Riser Rated: Type CMR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Siemon.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

2.5 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Corning Cable Systems.

B. Refer to drawing equipment list for use of hybrid and indoor/outdoor cable.

C. Description: Multimode, 62.5/125-micrometer, nonconductive tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
4. Provide number of strands as indicated.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
   a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.
   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
   c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
   d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
   e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
   f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666. Retain first subparagraph below even if nonconductive cable is specified above. If both conductive and nonconductive cables are specified, indicate locations of each on Drawings.
6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

D. Description: Singlemode, nonconductive, noncuductive tight buffer, optical fiber cable. Comply with ICEA S-83-596 for mechanical properties.
1. Comply with ICEA S-83-596 for mechanical properties.

2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
4. Provide number of strands as indicated.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
   a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.
   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
   c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
   d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
   e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
   f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666. Retain first subparagraph below even if nonconductive cable is specified above. If both conductive and nonconductive cables are specified, indicate locations of each on Drawings.
   g. Maximum Attenuation: 0.5 dB/km at 1310 and 1550 nanometers
   h. Minimum Modal bandwidth: 20 GHz at 1310 and 1550 nanometers

E. Jacket:
1. Jacket Color: Orange for 62.5/125-micrometer cable and yellow for single mode.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but are not limited to, the following:
1. Siemon

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Cable Connecting Hardware:
1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

B. Install all equipment in accordance with Seismic requirement in Division 1.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified on drawings. Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:
1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits **3 inches (76 mm)** above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than **60 inches (1524 mm)** apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable **6 feet (1800 mm)** long not less than **12 inches (300 mm)** in diameter below each feed point.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
   1. Administration Class: 2.
   2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. See Division 13 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion about TIA/EIA standard as it applies to this Section.Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.

D. Comply with requirements in Division 13 Section "Communications Horizontal Cabling" for cable and asset management software.

E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

G. Cable and Wire Identification:
   1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
   2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
   3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
   4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
4. Optical Fiber Cable Tests:
   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   b. Link End-to-End Attenuation Tests:
      1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
      2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 13741

SECTION 13742 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Comply with UVU Master Specs

1.2 SUMMARY

A. Section Includes:
1. Pathways.
2. UTP cabling.
3. 62.5/12-micrometer and 50/125-micrometer, optical fiber cabling.
4. Coaxial cable.
5. Multiuser telecommunications outlet assemblies.
6. Cable connecting hardware, patch panels, and cross-connects.
7. Telecommunications outlet/connectors.
8. Cabling system identification products.
9. Cable management system.
10. Singlemode

B. Related Sections:
1. Division 13 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. UVU Master Specs

1.3 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. BICSI: Building Industry Consulting Service International.

C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.

D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

F. EMI: Electromagnetic interference.

G. IDC: Insulation displacement connector.

H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

I. LAN: Local area network.

J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

L. RCDD: Registered Communications Distribution Designer.

M. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.

N. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.

O. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
   1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
   2. Horizontal cabling shall contain no more that one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
   3. Bridged taps and splices shall not be installed in the horizontal cabling.
   4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

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

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics, including the following:
   a. Cross-connects.
   b. Patch panels.
   c. Patch cords.
5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
   a. Vertical and horizontal offsets and transitions.
   b. Clearances for access above and to side of cable trays.
   c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
   d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration and faceplates for color selection and evaluation of technical features.

D. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

E. Source quality-control reports.

F. Field quality-control reports.

G. Maintenance Data: For splices and connectors to include in maintenance manuals.

H. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

1. Installer Qualifications: Company specializing in the installation of augmented category 6 (CAT 6A) and fiber optic Structured Wiring Systems with minimum 5 years documented experience. Contractor shall have a minimum of one person on job site at all times with documented formal training in the installation of Augmented Category 6 (CAT 6A), and fiber optic cabling systems if fiber optic cabling is required. Installers shall posses a certification for a total systems solution issued by the manufacturers of the cabling and terminating hardware. The contractor must present this certification to the contracting officer before beginning work. The contractor shall have on staff a Registered Communication Distribution Designer (RCDD) as certified by Building Industry Consulting Services International (BICSI). Installer shall be Siemon CI certified.

B. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings and field testing program development by an RCDD.

1. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
2. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

D. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

G. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for **two** years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
   1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.12 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Patch-Panel Units: One of each type.
   2. Connecting Blocks: One of each type.
   3. Device Plates: One of each type.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars, spools, J-hooks, and D-rings.
   3. Straps and other devices.

C. Cable Trays:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cablofil Inc.
      b. Cooper B-Line, Inc.
      c. GS Metals Corp.

   2. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch (0.055 mm) thick.
      a. Basket Cable Trays: **provide width as indicated on drawings** and 4 **inches (100 mm)** deep. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
      b. Ladder Cable Trays: Nominally **18 inches (455 mm)** wide, and a rung spacing of **12 inches (305 mm)**.

D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."Flexible metal conduit shall not be used.
   1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Mohawk
   2. General
   3. Siemon

B. Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with TIA/EIA-568-B.1 for performance specifications.
   3. Comply with TIA/EIA-568-B.2, Category 6.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
      a. Communications, General Purpose: Type CM or CMG; CMP or CMR.
      b. Communications, Plenum Rated: Type CMP complying with NFPA 262.
      c. Communications, Riser Rated: Type CMR or CMP, complying with UL 1666.

2.4 UTP CABLE HARDWARE

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

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 66-style IDC for Category 3. Provide blocks for the number of cables terminated on the block, plus **25** percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
   1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
   1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair cables in **48-inch (1200-mm)** lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.5 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Corning Cable Systems.

B. Provide hybrid cable as indicated on drawings.

C. Description: Multimode, 62.5/125-micrometer, nonconductive tight buffer, optical fiber cable.
   1. Comply with ICEA S-83-596 for mechanical properties.
   2. Comply with TIA/EIA-568-B.3 for performance specifications.
   3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
   4. Provide number of strands as indicated.
   5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
      a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.
      b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
      c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
   6. Maximum Attenuation**:** 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
   7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

D. Description: Singlemode, nonconductive, noncuductive tight buffer, optical fiber cable. Comply with ICEA S-83-596 for mechanical properties.
   1. Comply with ICEA S-83-596 for mechanical properties.
   2. Comply with TIA/EIA-568-B.3 for performance specifications.
   3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
   4. Provide number of strands as indicated.
   5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

      a. General Purpose, Nonconductive: Type OFN or OFNG**,** or OFNR, OFNP.
      b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
      c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
      d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
      e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
      f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666. Retain first subparagraph below even if nonconductive cable is specified above. If both conductive and nonconductive cables are specified, indicate locations of each on Drawings.
   6. Maximum Attenuation: 0.5 dB/km at 1310 and 1550 nanometers
   7. Minimum Modal bandwidth: 20 GHz at 1310 and 1550 nanometers

E. Jacket:
   1. Jacket Color: Orange for 62.5/125-micrometer cable, yellow for single mode cable.
   2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
   3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Siemon
   2. Corning Landscape

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
   1. Number of Connectors per Field: **One** for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Cable Connecting Hardware:
   1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
   2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.
   3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: multi-port-connector assemblies mounted in single or multigang faceplate.

   1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
   2. Metal Faceplate: Stainless steel, complying with requirements in Division 26 Section "Wiring Devices."
   3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
      a. Flush mounting jacks, positioning the cord at a 45-degree angle.
   4. Legend: Factory labeled by silk-screening or engraving for stainless steel, brass faceplates.
   5. Legend: Machine printed, in the field, using adhesive-tape label.
   6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.8 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.9 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.10 CABLE MANAGEMENT SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. iTRACS Corporation.
   2. Telsoft Solutions.

B. Description: Computer-based cable management system, with integrated database and graphic capabilities.

C. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.

D. Information shall be presented in database view, schematic plans, or technical drawings.
   1. AutoCAD drawing software shall be used as drawing and schematic plans software.

E. System shall interface with the following testing and recording devices:
   1. Direct upload tests from circuit testing instrument into the personal computer.
   2. Direct download circuit labeling into labeling printer.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 Comply with seismic requirements outlined in Division 1.

3.3 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.4 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 13 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:
   1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
   2. Install cable trays to route cables if conduits cannot be located in these positions.
   3. Secure conduits to backboard when entering room from overhead.
   4. Extend conduits **3 inches (76 mm)** above finished floor.
   5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.5 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   1. Comply with TIA/EIA-568-B.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
   a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
   b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than **60 inches (1524 mm)** apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable **6 feet (1800 mm)** long not less than **12 inches (300 mm)** in diameter below each feed point.

G. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.

2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

H. Group connecting hardware for cables into separate logical fields.

I. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (113 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.6 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.7 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.8 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
   1. Administration Class: 2.
   2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.

E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

G. Cable and Wire Identification:
   1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
   2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
   3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
   4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
      a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
      b. Label each unit and field within distribution racks and frames.

   5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.

Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
   1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
   2. Visually confirm Augmented Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
   3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
      a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   5. Optical Fiber Cable Tests:
      a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
      b. Link End-to-End Attenuation Tests:
         1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
         2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
   6. UTP Performance Tests:
      a. Test for each outlet. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
         1) Wire map.
         2) Length (physical vs. electrical, and length requirements).
         3) Insertion loss.
         4) Near-end crosstalk (NEXT) loss.
         5) Power sum near-end crosstalk (PSNEXT) loss.
         6) Equal-level far-end crosstalk (ELFEXT).
         7) Power sum equal-level far-end crosstalk (PSELFEXT).
         8) Return loss.

9) Propagation delay.
10) Delay skew.

7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
8. Coaxial Cable Tests: Conduct tests according to Division 13 Section "Master Antenna Television System."
9. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
   a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
   b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION 13741

SECTION 15000 - GENERAL MECHANICAL REQUIREMENTS

PART I - GENERAL

1.1 RELATED DOCUMENTS:

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

Sections of other Divisions which relate to mechanical work apply to the work of this section. See various Sections on site work, under floor work, structural work, finish materials, etc.

B. Related Sections: Refer to Division 16 for basic electrical requirements for all mechanical equipment. Special and specific electrical requirements are specified within each respective equipment specification section.

1.2 SUMMARY: This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Division 15. It expands and supplements the requirements of Division 1.

This Division does not define, nor is it limited by, trade jurisdictions. All work described herein is a part of the General Contract and is required of the Contractor regardless.

1.3 DESCRIPTION OF PROJECT: The mechanical work described in these mechanical specifications is for a project located in Orem, Utah. Design weather conditions are: 95° db, 62° wb, and winter 3°F. Altitude readings, unless otherwise noted, are for an elevation of 4,500 feet above sea level. Make adjustment to manufacturer's performance data as needed.

1.4 CODES AND PERMITS, AUTHORITIES HAVING JURISDICTION:

A. Perform the mechanical work in strict accordance with the applicable provisions of the various codes ordinances and adoptions pertaining to the project location in effect on the date of invitation for bids. Provide all materials and labor necessary to comply with rules, regulations and ordinances. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications govern.

B. Hold and save the Owner and Architect/Engineer free and harmless from liability of any nature or kind arising from failure to comply with codes and ordinances.

C. Secure all permits necessary for the prosecution of the work under this contract. Owner to pay all fees including connection fees related to utility hookups.

D. Reference Standards:

American Welding Society
International Mechanical Code/State Code
International Building Code/State Code
International Fire Code
International Energy Code
SMACNA Duct Design Standards
Local/State Plumbing Code
Locally enforced NFPA Codes
Local Fuel Utility Regulations

Local Power Utility Regulations
American Gas Association
ASME Codes for Pressure Vessels and Piping
ANSI B31.1 Piping

E. Final inspection by the Architect/Engineer will not be made nor Certificate of Substantial Completion issued until certificates of acceptability from the Authorities having jurisdiction are delivered.

1.5 DEFINITION OF PLANS AND SPECIFICATIONS: The mechanical drawings at reduced scale show the general arrangement of piping, ductwork, equipment, etc., and shall be followed as closely as the actual building construction and the work of other trades will permit. The architectural and structural drawings shall be considered as part of the work insofar as these drawings furnish the Contractor with information relating to design and construction of the building. Architectural drawings shall take precedence over mechanical drawings. Request clarification and participate in resolution in the event of conflict.

Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate the structural and finish conditions affecting the work and arrange the work accordingly, providing such extensions, fittings, valves and accessories to meet the conditions as may be required. Some small scale work is not shown such as control conduit and piping, incidental piping, specialties. Provide as directed by note or specification.

Examine the actual construction site prior to bidding and obtain an understanding of the conditions under which the work will be performed. No allowances will be made for failure to make such examination.

During construction, verify the dimensions governing the mechanical work at the building. No extra compensation shall be claimed or allowed because of differences between actual dimensions and those indicated on the drawings. Examine adjoining work on which mechanical work is dependent for perfect efficiency, and report any work of other trades which must be corrected. No waiver of responsibility for defective work shall be claimed nor allowed due to failure to report unfavorable conditions affecting the mechanical work.

1.6 ROUGH-IN:

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

1.7 MECHANICAL INSTALLATIONS:

A. Coordinate mechanical equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Provide openings in building components to allow for mechanical installations. Provide all required saw cutting and core drilling.

D. 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.

E. Coordinate the cutting and patching of building components to accommodate installation of mechanical equipment and materials.

F. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

G. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

H. Coordinate the installation of mechanical materials and equipment above ceilings with suspension systems, light fixtures, existing structures and other installations.

I. 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.

1.8 ACCESSIBILITY:

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing..

B. Establish required clearance to all installation features involving operation and maintenance. Respect manufacturers recommendations for access and clearance.

C. Access Doors - General: All items of mechanical equipment which may require adjustment, maintenance, replacement or which control a system function shall be made readily accessible to personnel operating the building.

1. Provide access doors in all ductwork or plenums as required to maintain fire dampers, fire smoke dampers, equipment, controls or other elements of the system. Doors shall conform to SMACNA standards unless otherwise detailed or specified. Refer to 15910 for sizes.

1.9 CHANGE ORDERS: See General Conditions.

1.10 ALTERNATIVE CONSTRUCTION/SUBSTITUTION: These documents outline a way in which the Owner may be delivered a functional and reliable facility. Drawings and specifications describe reasonable engineering practice for the Contractor to follow.

Coordination between trades may result in periodic needs to adjust the installation from that indicated, but in no case shall the intended function be compromised.

The Contractor may perceive some work methods which differ from those specified which could save time and effort. These may be presented to the Architect with a breakdown of possible cost savings for review. Implement only with authorization.

Materials substitutions will generally be covered in a review process prior to bidding. After bidding, substitutions shall be proposed only on the basis of definitive cost accounting and implemented only with authorization.

1.11 CUTTING AND PATCHING:

A. Cut and patch only as needed.

B. Refer to the Division 1 Section: CUTTING AND PATCHING for general requirements for cutting and patching.

C. Refer to Division 16 Section: BASIC ELECTRICAL REQUIREMENTS for requirements for cutting and patching electrical equipment, components, and materials.

D. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

E. Arrange for repairs required to restore other and any work damaged as a result of mechanical installations.

F. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.

G. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work;

2. Remove and replace defective Work;

3. Remove and replace Work not conforming to requirements of the Contract Documents;

4. Remove samples of installed Work as specified for testing:

5. Install equipment and materials in existing structures.

H. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

1.12 SUBMITTALS: Submittal of shop drawings, product data, and samples will be accepted only from the Contractor to the Architect. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed. Document each transmittal and sign and stamp the submittal indicating that it has been reviewed and is in compliance with the criteria of the project, any exceptions being clearly noted.

A. Shop Drawings: As soon as possible after the contract is awarded, submit to the Architect, seven (7) copies of the descriptive literature covering all equipment and materials to be used in the installation of mechanical systems for this project. Written confirmation of acceptable review by the Owner's Representative shall be obtained before ordering, purchasing, acquiring or installing any such equipment or materials for the project.

Prepare the submittals in an orderly manner after the order of this specification, contained in a three-ring looseleaf binder(s) with identification tabs for each item or group of related items. Submitted literature shall clearly indicate performance, quality, utility requirements, dimensions of size, connection points and other information pertinent to effective review.

Equipment must fit into the available space with allowance for operation, maintenance, etc. The Contractor shall take full responsibility for space and utility requirements for equipment installed.

Factory-wired equipment shall include shop drawings of all internal wiring to be furnished with unit.

Review of the Architect/Engineer is for general conformance of the submitted equipment of the project specification; in no way does such approval relieve Contractor of his obligation to furnish equipment and materials that comply in detail to the specification, nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions which may affect his work.

B. Record Drawings: During the course of construction, maintain a set of drawings, specifications, change orders, shop drawings, addenda, etc., for reference and upon which all deviations from the original layout are recorded. Turn these marked-up documents over to the Architect/Engineer at the conclusion of the work so that the original tracings can be revised. If the Contractor fails to mark up the prints, reimburse the Architect/Engineer for time required to do so.

1.13 OPERATION AND MAINTENANCE TRAINING:

A. Instruction Of Owner's Personnel: At a time prior to Owner making use of a device or system, and in general after testing and balance work for a building or major system is complete, prepare, schedule and conduct a series of training sessions for Owner's operating and supervisory personnel. Instructions shall cover each device and system with emphasis on understanding of the purpose and function, the maintenance requirements and the proper adjustment and operating technique.

B. Instruct building operating staff in operation and maintenance of mechanical systems utilizing Operation and Maintenance Manual when so doing.

1.14 GUARANTEE/WARRANTY: The following guarantee is a part of this specification and is binding on the part of the Contractor and his assigns:

"Contractor guarantees that this installation is in accordance with the terms of the Contract and is free from mechanical defects. He agrees to replace or repair, to the satisfaction of the Owner's Representative, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance. See also the General Conditions of these specifications. Failed equipment in the repair or replacement shall be guaranteed for one full year from the date of recommission."

Compile and assemble the warranties required by Division 15 into a separated set of vinyl covered, insert sheets, tabulated and indexed for each reference, included in the O & M Manual.

Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

Mechanical systems and equipment shall not be considered for substantial completion and initiation of warranty until they have performed in service continuously without malfunction for at least thirty (30) working days.

1.15 TESTS AND CERTIFICATIONS: Make all tests required by code or specification in the presence of a representative of the Owner, with tests recorded and certified by the Contractor and Representative. Involve local authorities where required.

1.16 PERMITS, FEES, LICENSES: Refer to General Conditions. See Paragraph 1.4.

1.17 CEILING SPACE COORDINATION: Carefully coordinate ceiling cavity space with all trades. Respect clearances required for lights, electrical conduits, protected structure, etc. All spaces above any and all ceilings shall be defined and considered as return air plenum space. Coordinate installation of new with existing systems and conditions.

PART II - GENERAL MECHANICAL MATERIALS AND METHODS

2.1 QUALITY OF MATERIALS AND EQUIPMENT:

A. All equipment and materials shall be new, and shall be the standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment, and shall be the manufacturer's latest design. Specific equipment shown in schedules on drawings and specified herein is to be the basis for the Contractor's bid. Provisions for substitute equipment are outlined in the General Conditions. All materials shall be produced by manufacturing plants located in the United States of America.

B. Furnish and install all major items of equipment specified in the equipment schedules on the drawings complete with all accessories normally supplied with catalog items listed, and all other accessories necessary for a complete and satisfactory installation.

2.2 PROTECTION OF MATERIALS AND EQUIPMENT:

A. Close pipe and duct openings with caps or plugs to prevent lodgement of dirt or trash during the course of installation. Cover equipment tightly and protect against dirt, water and chemical or mechanical injury

2.3 QUALIFICATIONS OF WORKMEN:

A. All mechanics shall be capable journeymen, skilled in the work assigned to them. Apprentices may be used with appropriate direction.

B. Employ no unskilled persons in the work which he is given to do; execute all work in a skillful and workmanlike manner.

C. All welders involved in welding of pressure piping systems shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Written verification of successful test completion shall be submitted to Architect prior to initiating work.

2.4 FOREMAN: Dedicate and designate a general mechanical foreman to the Owner's Representative to be available on site during the life of the project for consultation. Do not replace this individual without prior approval from the Owner's Representative.

2.5 USE OF COMMON VENDORS: Regardless of subcontract delegations, coordinate purchasing between trades so that equipment and materials of similar nature come from a single vendor, i.e., all package HVAC terminal units shall be common source. Diffusers etc., the same. Do not burden the Owner with multiple brands of similar equipment unless so directed.

2.6 HANGERS AND SUPPORTS (GENERAL):

A. Provide hangers and/or supports for all equipment, piping and ductwork. Primary information is contained in these specifications and on the drawings.

B. Provide hangers and supports to correlate with seismic restraint and vibration isolation.

2.7 MANUFACTURER'S DIRECTIONS: Install all equipment in strict accordance with directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the plans and specifications, report such conflicts to the Architect who shall direct adjustments as deemed necessary and desirable.

2.8 ELECTRICAL WIRING AND CONTROL:

A. In general, motor starters, related motor starter equipment and power wiring indicated on the electrical drawings and control diagrams are to be furnished and installed under Division 16000 of this Specification. Items of electrical control equipment specifically mentioned to be furnished by the Division 15000 either in these specifications or on the electrical or mechanical drawings, shall be furnished and mounted by this Contractor and shall be connected under and as required by this Division 15000 and Division 16000 of these specifications.

B. Refer to the control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the contractor.

C. Division must be fully coordinated with Division 16000 to insure that all required components of the work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of coordination.

D. Where the detailed electrical work is not shown on the electrical drawings, the Mechanical Contractor shall furnish, install and wire or have prewired all specified and necessary controls for air handling, heating and ventilating equipment specified for this project. The objective of this paragraph is to make sure a complete operating system is obtained at no additional cost to the Owner for field wiring required related to the equipment.

2.9 FLUSHING AND DRAINING OF SYSTEMS/CLEANING OF PIPING AND DUCTS: Fill, clean and flush and sterilize where appropriate, all water piping systems with water and drain these systems before they are placed in operation. Flushings shall consist of not less than six (6) short, intermittent flushes of five (5) to ten (10) minutes duration. Sample and test each flush for cleanliness.Blow out all other piping systems with compressed air or nitrogen to remove foreign materials that may have been left or deposited in the piping system during its erection. Duct systems shall have all debris removed and fans shall be run to blow out all dust and foreign matter before grilles, outlets or mixing boxes are installed and connected. .

2.10 JOBSITE CLEANUP:

A. Keep site clean during progress of work.

B. At the conclusion of work, clean all installation thoroughly.

1. Leave equipment in a factory dock condition. Correct any damage and touch up or repaint if necessary.

2. Remove all debris from site.

END OF SECTION 15000

SECTION 15005 - DEMOLITION

PART I - GENERAL

1.1 SCOPE:

A. Demolition includes work shown on the drawings as required to allow for installation of new work.

1.2 REFERENCES:

A. General Conditions, Supplemental General Conditions, Division 1, etc.

B. General Requirements of Technical Divisions.

1.3 PROJECT/SITE CONDITIONS:

Be familiar with site conditions and be careful in the work. The Contractor shall visit the site prior to bidding and shall make themselves familiar with all existing conditions and the extent of the demolition work required and shall include all related cost in their bid.

1.4 SCHEDULING AND SEQUENCING:

A. Program and schedule any required interruptions of primary utility service with University staff 72 hours prior to proposed shutdown. Do not create unscheduled interruptions or interference with campus functions.

B. Protect from damage all existing systems that are to remain in operation.

PART II - PRODUCTS

PART III - EXECUTION

3.1 DUCTWORK AND EQUIPMENT:

Remove ductwork and equipment rendered obsolete by this work and as designated on the drawings. Cap exposed ends of operating systems, air tight. Dispose of removed material offsite.

3.2 PIPING AND EQUIPMENT:

A. Remove piping and equipment, rendered obsolete by this work and as designated on the drawings. Cap operating piping systems at valves. Dispose of removed material off-site. Identify capped ends to be able to properly restore directional flow.

3.3 CONTROLS:

A. Remove all controls associated with any and all to be removed mechanical systems.

B. Prior to demolition of any pneumatic control device, thermostat, etc., the pneumatic control air tubing shall be valved off capped immediately. Cap tubing back at mains.

END OF SECTION 15005

SECTION 15195 - OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.

B. Division-15 General Mechanical Requirements sections apply to work of this section.

1.2 SUMMARY:

A. Furnish two sets of bound operation and maintenance manuals. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.

1.3 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS:

A. General:

1. The "Operating and Maintenance Manual" is a bound compilation of drawings and data that the owner requires for each building or project. These manuals, complete with drawings and data, shall be furnished to the Owner.

2. The mechanical contractor has overall responsibility to obtain the necessary data and compile the data as set forth in this specification, including items or equipment purchased by the Owner and delivered to the contractor for installation.

3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.2A.

4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.

B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

PART II - MATERIALS AND METHODS

2.1 PAGE SIZE: All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 16 x 11 inches) folded to 8-1/2 x 11 inch.

2.2 DRAWINGS: All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manilla pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manilla pocket.

2.3 BINDERS: Binders shall be Buckram 3-ring binders for sheet size 8-1/2 x 11 inches with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, however, shall be based on not filling them beyond 4".

A. Place the following information on the front cover and backbone:

1. "Operation and Maintenance Manual".

2. Project Name (and volume number if more than one volume).

3. “UVU Woodbury School of Business Remodel”.

4. Architect's name.

5. Engineer's name.

6. General Contractor's name.

7. Mechanical Contractor's name.

8. Items 4 through 7 need not be printed on the backbone.

2.4 CONTENTS AND INDEXING:

A. Manuals shall contain descriptions of the building systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.

B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.

C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:

1. Copy of purchase order change (if any).

2. Outline drawings, special construction details, “as built” electrical wiring and control diagrams for all major and supplementary systems.

3. Manufacturer’s test or calculated performance data and certified test curves.

4. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.

5. Manufacturer’s brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.

6. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.

7. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:

a. Part I Purchased Equipment Data

b. Part II Test Reports and Valve Charts
c. Part III Start-Up and Operation
d. Part IV Preventative Maintenance Recommendations

8. A copy of the approved submittals for each piece of equipment.

9. A copy of all testing, adjusting and balancing reports.

10. Wiring diagrams, marked with model and size and plan symbol.

11. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

END OF SECTION 15195

SECTION 15240 - MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL

PART I - GENERAL:

1.1 RELATED DOCUMENTS:

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

B. This section is Division-15 Mechanical Sound, Vibration and Seismic Control section, and is part of each Division-15 section making reference to mechanical sound, vibration and seismic control specified herein.

C. Division-15 General Mechanical Requirements apply to work of this section.

SUMMARY: Furnish and install complete seismic restraint and vibration control systems for all new work installed under Division 15. Work to be responsive to the intent of the International Building Code, latest adopted edition, for the respective seismic zone.

1.2 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Engage the services of an independent seismic and vibration control subcontractor who has the technology, experience, computer capabilities and manufactured products to prepare the required computations, shop drawings and special devices to meet the minimum requirements described herein. Select from the following:

1. Amber Booth
2. Kinetics
3. Mason
4. Vibro Acoustics

B. The seismic and vibration control subcontractor shall visit the site during construction at a minimum of two specific periods.

1. When equipment is set in place, prior to placement of seismic restraint devices for the purposes of directing the contractor in properly locating and installing the approved devices.

2. At the completion of the project, prior to final mechanical inspection, for the purpose of verifying the correctness of the seismic restraint and vibration isolation device installation and preparing certification of the seismic vibration-isolation work.

C. The seismic subcontractor shall exercise the quality control for this work and shall include, but not be limited to instructions direct to the Mechanical (Division 15) Contractor concerning:

1. Anchoring of all new mechanical equipment.

2. Bracing and anchoring of all new ductwork, piping and conduit.

3. Provision for expansion and vibration of all new piping.

D. The subcontractor shall be responsible for identifying the need for the size and location of

steel sole plates and their attachment to structural steel or concrete.

E. The subcontractor shall certify in writing that he has inspected the installation and that all isolation, anchors and seismic restraint materials are installed correctly and functioning properly. Certification shall be provided after all corrective work has been completed.

1.3 SUBMITTALS:

A. Submittal data is required and shall consist of computations, vibration isolation selection, equipment anchors, anchor bolt sizes, supports, seismic restraints, sole plate data, restraint locations and type of restraints.

B. Submittal data shall identify dimensions, load deflection data, center of gravity, standard connections, manufacturer's recommendations, behavior problems including vibrations, thermal expansion, building expansion joints, etc., associated with equipment, ductwork, piping and conduit. Provide detailed submittal drawings of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter and depth of penetration of anchors. Include rating for loads.

C. Selection of isolator anchors and restraints shall be clearly made known along with the basis for selection so that proposed systems can be reviewed.

D. Provide calculations for all selected anchors, anchor bolts, sole plates, vibration isolators seismic restraints and other support steel for restraining devices. Certification documents shall be signed and stamped by an engineer licensed in the State of Utah.

1.4 REFERENCES:

A. Codes and Standards: (Latest adopted edition)

1. International Building Code
2. ASCE 7-05

1.5 PERFORMANCE REQUIREMENTS:

A. Soil Site Class D
B. Occupancy Category III
C. Importance Factor 1

PART II - PRODUCTS:

2.1 MATERIALS - PRODUCTS: Restraint devices shall be especially designed to resist seismic forces in all directions.

A. Snubbers: Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer neoprene (bridge bearing neoprene) to protect equipment. Restraints shall allow a maximum of 1/4" before engaging and shall not interfere in normal starting or stopping operation. Housing shall allow for visual inspection to determine clearances during system operation. Restraints shall be field adjustable and be positioned for up to 1/4" clearance both horizontally and vertically. Mountings and snubbers are to be manufactured under a Quality Assurance (QA) Program.

B. Snubbers and Isolator Combination Devices: Combination unitized devices may be used where equipment isolation is required. They shall include the requirements listed for snubbers. Isolation portion shall be stable spring type with combination leveling bolt and equipment fastening device. Base plate shall have adequate means for bolting to structure. The spring assembly shall be removable and shall fit within a welded steel

enclosure.

C. Piping, Conduit and Duct Restraints:

1. Seismic wire rope cable restraints shall consist of steel wire strand cables, sized to resist project seismic loads, arranged to offer seismic restraint capabilities for piping, ductwork, and suspended equipment in all lateral directions.

2. Building and equipment attachment brackets at each end of the cable shall be designed to permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points as required to eliminate potential for dynamic cable wear and strand breakage.

3. Restraints shall be sized to the capacity of the cable or to the capacity of the anchorage, whichever is the lesser.

4. Seismic wire rope connections shall be made using overlap wire rope “U” clips or seismically rated tool-less wedge insert lock connectors.

5. Vertical suspension rods shall be braced as required to avoid potential for buckling due to vertical ‘up’ forces. Braces shall be structural steel angle uniquely selected to be of sufficient strength to prevent support rod bending. Brace shall be attached to the vertical suspension rod by a series of adjustable clips. Clips shall be capable of securely locking brace to suspension rod without the need for hand tools.

6. Where clevis hanger brackets are used for seismic restraint attachment, they will be fitted with clevis internal braces to prevent buckling of the hanger brackets.

PART III - EXECUTION

3.1 SEISMIC RESTRAINT-PIPING AND CONDUIT:

A. General: All new piping and conduit shall be protected in all planes by restraints, designed to accommodate thermal movement while at the same time restraining seismic motion. Brace piping to code requirements of IBC and ASCE 7-05.

B. Installation of all seismic restraint materials shall be accomplished per the manufacturer’s written instructions.

C. Attach piping to the trapeze per seismic restraint manufacturer’s design. Install cables so they do not bend across sharp edges of adjacent equipment or building structures.

D. Install vertical braces to stiffen hanger rods and prevent buckling per seismic restraint manufacturer’s design. Clamp vertical brace to hanger rods. Requirements apply equally to hanging equipment. Do not weld vertical braces to hanger rods. Seismic Restraint for Piping and Ductwork

E. Seismically restrain all new piping. Use Type J Cable Restraints for all piping supported by vibration isolation hanger assemblies, including:

3.2 SEISMIC RESTRAINT- DUCTWORK:

1. Seismically restrain all new ductwork listed below:

A. All new rectangular and oval ducts with cross sectional area equal to or greater than 6 sq. ft. (0.55 sq. meters).

B. All new round ducts with diameters equal to or greater than 32 in (812 mm).

C. Brace all new remaining ductwork including VAV and DVAV terminal boxes to code requirements of IBC and ASCE 7-05.

END OF SECTION 15240

SECTION 15250 - MECHANICAL INSULATION

PART I - GENERAL

1.1 RELATED DOCUMENTS:

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

B. Division-15, Section 15000 - General Mechanical Requirements applies to work of this section.

1.2 SUMMARY:

A. Extent of mechanical insulation required by this section is indicated on drawings and schedules as required by the current International Energy Code, and by requirements of this section. Use no asbestos in this work. Include restorations of insulations of damaged work including repair of damaged existing insulation due to new work.

B. Types of mechanical insulation specified in this section include the following:

1. Ductwork System Insulation:

a. Fiberglass.
b. Rigid Flexible Wrap.
c. Flexible fire protection wrap.

C. Refer to Division-15 section "Supports and Anchors" for protection saddles, protection shields, and thermal hanger shields.

D. Refer to Division-15 section "Ductwork" for duct linings.

E. Refer to Division-15 section "System Identification" for installation of identification devices for piping, ductwork, and equipment.

1.3 QUALITY ASSURANCE:

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer’s Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Deliver insulation, coverings, cements, adhesives and coatings to site in containers with manufacturer's stamp or label affixed showing fire hazard ratings of products.

B. Protect insulation against dirt, water and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART II - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide mechanical insulation materials of one of the following (except as noted):

1. Armstrong World Industries, Inc.
2. Babcock and Wilcox Co., Insulating Products Div.
3. CertainTeed Corp.
4. Knauf Fiber Glass GmbH.
5. Manville Products Corp.
6. Owens-Corning Fiberglass Corp.
7. Pittsburgh Corning Corp.

2.2 DUCTWORK INSULATION MATERIALS:

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1. Class 1 - 400°F (204°C); Class 2 - 400°F (204°C); Class 3 - 850°F (454°C); Class 4 - 1000°F (538°C); Class 5 - 1800°F (982°C); Class 1 - 10 lbs/ft^{3}; Class 2, 3 and 4 - 12 lbs/ft^{3}; class 5 - 20 lbs/ft^{3}.

B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, Class B-4. Type 1 - resilient, flexible; Class B-1 - 0.65 lbs/ft^{3}; Class B-2 - 0.75 lbs/ft^{3}; Class B-3 - 1.0 lbs/ft^{3}; Class B-4 - 1.5 lbs/ft^{3}; Class B-5 - 2.0 lbs/ft3; Class B-6 - 3.0 lbs/ft^{3}; Type II - flexible; Class F-1 - 4.5 lbs/ft^{3}; Type III - semirigid; Class F-2 - 4.5 lbs/ft^{3}.

C. Jackets for Ductwork Insulation: ASTM C 921, Type I for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes ad similar compounds as recommended by insulation manufacturer for applications indicated.

PART III - EXECUTION

3.1 DUCTWORK SYSTEM INSULATION:

A. Insulation Not Required: Do not insulate lined ductwork.

B. Hot, Cold and Dual Temperature Ductwork:

1. Application Requirements: Insulate the following ductwork:

a. All new HVAC supply ductwork between fan discharge, or HVAC unit discharge, and room terminal outlet. Insulate neck and bells of supply diffusers.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

a. Flexible Fiberglass: Type 1, Class B-4, 1-1/2” lb/ft^3 density, 1-1/2" thick, application limited to concealed locations.

C. All new High and Medium Velocity Duct: Insulate externally with type 1, class B-4 (1-1/2 lb/ft^3 density) 1-1/2" thick fiberglass faced duct wrap with factory applied foil scrim Kraft facing U.L. 723 label.

D. Duct Insulations:

1. Wrap insulation snugly on the ductwork such that maximum thickness is maintained. Butt all circumferential joints and overlap longitudinal joints a minimum of 2". Adhere insulation with 4" strips of Insulation Bonding Adhesive, at 8" on center.

2. On circumferential joints, staple the 2" flange of the facing with 9/16" flare-door staples on 6" centers and taped with minimum 3" wide foil reinforcing Kraft tape. Tape all pin penetrations or punctures in the facing.

3.2 INSTALLATION OF DUCTWORK INSULATION:

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.

E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.

G. Ductwork Exposed to Weather: Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by manufacturer.

H. Corner Angles: Install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.3 PROTECTION AND REPLACEMENT:

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during construction period to avoid damage and deterioration.

END OF SECTION 15250

SECTION 15300 - FIRE PROTECTION SYSTEMS

PART I - GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of the contract apply to this section.

B. Technical sections which describe related work such as Division 16 apply to this section.

C. Other Division 15 specifications apply to this section.

1.02 SUMMARY:

Furnish all materials, equipment and supplies and perform all work and operations to modify, construct and make functional the fire protection systems in accordance with the drawings and these specifications. Reference to other specifications, codes, standards or manuals which are a part of these specifications, but are not included herein, shall be the latest adopted edition of these publications.

1.03 QUALITY ASSURANCE:

A. Manufacturers: Firm engaged in the manufacture of fire protection equipment of the type and sizes required to complete the project.

B. Installer: The sub-contractor for each of the fire protection systems shall be duly licensed by the state, county and city in which the project is being constructed. The sub-contractor must be engaged in the installation of automatic fire protection systems and be fully familiar with all local conditions, specified codes and requirements.

C. Designer: The designer for the fire sprinkler system shall be a staff employee of the "Installer" and shall be a Utah State licensed fire protection engineer or a Certified Engineering Technician in Fire Protection (NICET III). The Certification shall be active during the entire contract period. The designer shall certify that the drawings and installation are in accordance with the intent of the plans and specifications. The designer shall make a complete and final inspection of the installation, including operating all alarms, control valves checking all piping, seismic bracing, hangers, etc. After checking all components of the system, he shall provide a letter stating that the installation is complete, operational and in accordance with approved plans and specifications. If changes have been made in the installation since the plans were approved, the designer shall correct the shop drawings and provide as-built drawings to the Owner with the letter.

1.04 SUBMITTALS:

A. Shop Drawings: The fire sprinkler contractor shall prepare complete shop drawings for each remodel area. Shop drawings shall be coordinated with structure and with all other trades. Show ceiling grid, lights, grilles, ducts, registers and diffusers, smoke detectors, sound speakers, etc. Show heads symmetrically related to ceiling patterns and show heads centered in tiles in grid. The shop drawings shall contain, as a minimum, the

information outlined and listed in NFPA 13 chapter 8. Submit fire sprinkler drawings and hydraulic calculations to each Authority Having Jurisdiction for review prior to starting work. Final design shall incorporate all requirements of the AHJ's. Work only from reviewed documents.

B. Descriptive Data: Descriptive data shall be submitted on the following items of material and/or equipment. Such data shall consist of manufacturer's or supplier's catalog information in sufficient detail to allow verification that the material and/or equipment meets the specification requirements, or is equal to that specified.

1. All valves, trim, air compressors, pipe, fittings, couplings, sprinklers, valve tamper, low and high air pressure switches and water flow alarm devices.

C. Submittal Procedure: Submit 2 copies of the fire sprinkler drawings, calculations and equipment data to the Orem City Fire Department for review. Submit 6 copies of the fire sprinkler drawings, calculations and equipment data to general contractor. The general contractor shall retain one copy of the submittal, forward 5 copies to the project architect for distribution to the project engineer (3 Copies) and University Construction Coordinator (Two Copies). The University Construction Coordinator will distribute drawings to UVU personnel for review.

D. Upon completion of installation submit to Architect two copies each:

1. University, "Contractor's Material & Test Certificate for Aboveground Piping." Furnish a separate report for standpipe systems, wet-pipe systems and dry-pipe systems.

2. As-built shop drawings with designer's signature and certification number. As-Built drawings shall be submitted on Mylar.

1.05 REFERENCES:

A. CODES AND STANDARDS:

1. NFPA (National Fire Protection Association) 13, “Installation of Sprinkler Systems”, Current Edition.
2. IFC (International Fire Code), 2006.
3. IBC (International Building Code), 2006
4. Underwriters Laboratories “Fire Protection Equipment Directory”.
5. Factory Mutual Systems “Approval Guide”.
6. DFCM “Minimum Fire Sprinkler Design Criteria”.
7. Utah State Rules – R410 Public Safety, Fire Marshal.

1.06 GUARANTEE:

A. Furnish a one-year guarantee for all equipment, materials, and installation, including all labor, transportation, and equipment. Make all installation compliant with Utah State Fire Marshall requirements as part of the Guarantee.

PART II - AUTOMATIC FIRE SPRINKLER SYSTEMS:

2.01 SCOPE OF WORK:

A. To include revising of existing fire protection to cover remodeled areas of the building. Design and install revised automatic fire sprinkler system(s) in accordance with NFPA 13 throughout the remodeled portions of the buildings, including any combustible ceiling spaces and inside or around any building features which obstruct sprinkler discharge. The system shall be hydraulically designed. In areas where lay-in ceiling occur, heads shall be centered in tiles. The design shall be based upon the following:

1. Classrooms, corridors and offices: Ordinary hazard, 0.16 gpm over most remote 3000 square feet of floor space, including 250 gpm for hose at the point of connection.

2. All other areas including storage and mechanical/electrical areas: Ordinary hazard, Group II, 0.20 gpm over most remote 2,000 square feet, including 500 gpm for hose taken at the point of connection to the building.

3. The authorities having jurisdiction and whose approval of the systems is required include:

a. University Physical Plant.
b. Orem City Fire Marshall.
c. State of Utah Fire Marshall's Office.
d. Owners insurance company.
e. MJSA Architects/Heath Engineering Company.

4. Contractor to coordinate with UVU personnel to obtain the water flow test data at the existing building riser.

2.02 PIPING AND EQUIPMENT:

A. All equipment shall be U.L. listed and/or FM approved and installed in accordance with its listing and NFPA 13 requirements. Use only domestic piping and equipment - manufactured in USA.

B. All piping shall be domestic black steel, Schedule 40, piping conforming to ANSI/ASTM A53, ASTM A135 and ASTM A795.

C. Special pipe such as XL or other light wall pipe shall not be used.

D. Fittings shall be 175 lb. (cold water).

1. Cast iron, black or galvanized, screwed or flanged, UL approved, ASTM A-126, Class A, ANSI B16.4 or B16.1.

2. Malleable iron, screwed, black or galvanized, Class 150, UL approved, ANSI 16.3.

E. Unions two inches and smaller shall be 300 lb., black or galvanized as required to match piping, malleable iron, brass to iron seats, UL listed, ASTM A-197.

F. Flanges shall be 175 lb. (cold water), cast iron, black, flat-faced, screwed pattern, UL listed, ASTM A-126, Class A, ANSI B16.1.

G. Sprinkler Heads: Selection varies depending on occupancy and type of finish, all head styles and finishes based on compatibility with Architectural material, texture and color palette. Head locations to respect Architectural ceiling patterns. Reference plans for head style.

1. All spaces with finished ceilings: Reliable Model “G” semi-recessed sprinkler with white escutcheon and head. 1/2" orifice, 165°F rated.

2. Unfinished Ceiling Areas: Reliable Model G, upright or pendant, brass, 1/2" orifice, ordinary temperature rated. Sprinkler heads in Mechanical Equipment Rooms, and Janitor's Closet shall be furnished with guards.

3. Sidewall Installation: Reliable Model G, with white finish and white escutcheon, 165°F rating.

PART III - INSTALLATION:

3.01 INSTALLATION:

A. Install complete. Drawings generally indicate appropriate and desired location of heads in primary spaces. Pick up and provide coverage of incidental spaces not specifically treated on drawings.

B. Offset as needed for other trades. Avoid conflict in areas of tight construction. Run mains in beam and truss space where space between bottom of truss is insufficient for all. Do not obstruct access to air control boxes, access doors, lights or other ceiling mounted equipment. Modify installed work as needed to clear other installation.

C. Respect the concept of Uniform ceiling patterns and appearance.

D. Submit piping and equipment data sheets for review by the Architect/Engineer prior to start of the installation.

E. Cutting of structural members for the passage of sprinkler piping or for pipe hanger fastening is not permitted except with structural engineer’s concurrence. Selective sleeving through beams may be possible with structural engineers concurrence.

F. Provide sleeved holes through interior walls, floor, and ceilings large enough to accommodate pipe expansion. Seal around pipe penetrations with "Firesafeing" material.

G. Provide long runs of pipe with suitable means to permit free movement.

H. Close pipe openings with caps or plugs during installation. Cover and protect components of the system against dirt and chemical or mechanical injury.

I. Paint exposed piping for sprinkler system in accordance with requirements of Division 09000.

J. Install insulation, with facing towards interior, where indicated on the drawings. Follow insulation manufacturer's installation recommendations.

K. Note requirement for symmetrical head placement and centering in grid.

3.02 TESTING:

A. Hydrostatically test all system piping for two hours at 200 psi with no loss in pressure and no visible leakage. Conduct the testing after all of the fire sprinkler heads and piping are installed. Have the tests witnessed by the AHJ's and Engineer. Submit a Contractor's Material and Test Certificate to the Architect upon successful completion of the testing.

B. Train the Owner's maintenance personnel in the proper operation, testing and maintenance of all installed equipment.

C. Conduct an inspection and operational test (main drain and inspector's test) at the end of the one-year guarantee period. The inspection and testing shall be in accordance with manufacturer's recommendations and NFPA 13A. A written report is to be sent to the Owner upon completion of the inspection. Fire sprinkler installer shall conduct the tests.

END OF SECTION 15300

SECTION 15890 - DUCTWORK

PART I - GENERAL

1.1 RELATED DOCUMENTS:

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

B. Division 15 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.2 SUMMARY:

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork required for the project include the following:

1. Round
2. Rectangular
3. Oval
4. Spiral
5. Factory

C. Exterior Insulation of metal ductwork is specified in other Division 15 sections, and is included as work of this section.

D. Refer to other Division 15 sections for exterior insulation of metal ductwork; not work of this section.

E. Refer to other Division 15 sections for ductwork accessories; not work of this section.

F. Refer to other Division 15 sections for mechanical controls; not work of this section.

G. Refer to other Division 15 sections for louvers; not work of this section.

H. Refer to other Division 15 sections for grilles and diffusers; not work of this section.

I. Refer to other Division 15 sections for system commissioning, testing and balancing; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: A firm with at least 5 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

1. The installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

2. All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

B. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of General Conditions.

C. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of General Conditions.

1.5 REFERENCES:

A. Codes and Standards:

1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.

2. AMCA Compliance: Test and rate plenums in accordance with AMCA Standards.

3. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.

4. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems".

5. International Building Code/International Mechanical Code: Comply with all sections pertaining to mechanical work.

B. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, plenums, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts, fittings and plenums.

B. Storage: Where possible, store ductwork and plenums inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART II - PRODUCTS

2.1 DUCTWORK - GENERAL:

A. Standards: All duct fabrications shall comply with standards and techniques detailed by SMACNA "Duct Construction Manuals" for the appropriate pressure class, and with the ASHRAE Handbook, 1988 edition, Chapter 1, Duct Construction

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 90 zinc coating in accordance with ASTM A 525; mill phosphatized for exposed locations.

C. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting. Installation of exposed ductwork shall be laid out in advance and submitted for review. Ductwork shall be hung straight and uniform, points shall be true, seams shall show continuity.

2.2 FITTINGS AND FABRICATION:

A. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section. Unless specifically detailed otherwise, use 45° lateral and 45° elbows for branch take-off connections. Where 90° branches are indicated, provide conical type tees.

B. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.

C. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division 15 section "Duct Accessories' for accessory requirements.

D. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.

E. Offset, transition, adapt ductwork to structural obstacles and work of other trades in a coordinated effort. Layout work to avoid conflict with existing ductwork, piping, electrical, etc. With review of conditions, teardrop around conflicting piping, lights, etc., all at no added cost to the owner.

2.3 DUCT PRESSURE CLASSIFICATIONS:

A. For all VAV systems, which include but are not limited to

1. From fan discharge to air terminal unit: medium pressure ductwork, 6" w.g.

2. Rectangular supply air ductwork from air terminal unit, rectangular and round ductwork: Low pressure rectangular ductwork, 3" w.g. Low pressure round ductwork exposed to view spiral backseam, 3" w.g.

3. Branch round supply air ductwork runout from rectangular ductwork to diffuser: Low pressure round ductwork, 1" w.g.

2.4 LOW PRESSURE ROUND DUCTWORK: (1" SMACNA Pressure Class)

A. Round type ductwork for use on low velocity supply systems (1200 fpm maximum), low pressure (0.75" maximum duct pressure), shall be fabricated on 26 gauge galvanized steel sheets with snap-lock longitudinal seams and crimped and beaded joins or spiral ductwork may be used.

B. All end joints shall have at least three screw fasteners and shall be wrapped airtight. Transverse and longitudinal seams shall be taped with "Hardcast TA". Elbows and fittings shall provide smooth air flow patterns and have a neat appearance.

C. Use factory fabricated elbows of the multi-sectional adjustable type.

2.5 LOW PRESSURE RECTANGULAR DUCTWORK: (3" SMACNA Pressure Class)

A. Rectangular ductwork for use on supply systems up to 2" maximum duct static pressure and 2000 fpm maximum duct velocity shall be constructed of galvanized steel using construction for nominal 3" SMACNA rated systems. Seal all transverse joints with duct cement or tape with "Hardcast TA".

B. Use radius elbows or turning vanes with extended trailing edge. Use a true 1-1/2 time 45° tapping takeoffs with downstream balance damper.

C. Duct dimensions are inside clear. Increase for acoustical lining.

2.6 MEDIUM PRESSURE DUCTWORK: (6" SMACNA Pressure Class)

A. General: At Installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.

B. Round Ductwork: Construct of galvanized sheet steel complying with ASTM A 527 by the following methods and in minimum gauges listed.

Diameter	Minimum Gauge	Method of Manufacture
3" to 14"	26	Spiral Lockseam
15" to 26"	24	Spiral Lockseam
27" to 36"	22	Spiral Lockseam

Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.

C. Round Duct Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seams. Mitered elbows shall be of at least 5 piece construction with R/D ratio of 1.5. All branch takeoffs shall be a true 45º takeoff having an overall throat width at the main duct connection of 1-1/2 times the sizes of the branch duct.

Diameter	Minimum Gauge
3" to 36"	20

D. Flat-Oval Ductwork: Construct of galvanized sheet steel complying with ASTM A 527, of spiral lockseam or longitudinal seam construction, in minimum gauges listed.

Maximum Width	Minimum Gauge Spiral	Longitudinal
Under 25"	24	22
25" to 48"	22	20

E. Flat-Oval Duct Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams.

Maximum Width	Minimum Gauge
Under 37"	20
37" to 50"	18

F. Internally Insulated Duct and Fittings: Construct with outer pressure shell, 1" or 2" thick (as indicated on drawings) insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ASTM A 527, of spiral lockseam construction, use longitudinal seam for over 59", in minimum gauges listed. Use where indicated on drawings.

Equivalent to United McGill "Acoustic-K27".

Nominal Duct Diameter	Outer Shell	Inner Liner
3" to 12"	26 gauge	24 gauge
13" to 24"	24 gauge	24 gauge

G. Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams of outer shell. Construct fittings to close tolerance with ductwork.

Nominal Duct Diameter	Outer Shell	Inner Liner
3" to 34"	20 gauge	20 gauge

H. Field joints shall be made up using an initial coat of 3M EC-750 adhesive wrapping the joint with a 3" wide fiberglass strip and applying a final seal coat of adhesive to the fiberglass. Duct sections and fittings shall be held in place at joints with sheet metal screws 6" on centers. Simple coating of joint surfaces with mastic prior to joining is not acceptable (SMACNA Std. P.1-11).

I. Oval ductwork shall be installed where called for on the plans and where required to conform to tight space requirements encountered during construction. The contractor shall furnish transition pieces as required. Oval ductwork shall have equivalent capacity to the round duct.

At the Contractor's option odd inch diameter round ducts may be increased in size to the next larger even inch providing space considerations are accommodated and all related conditions are resolved by the contractor.

2.7 FACTORY DUCT:

A. Extent of Work: Provide factory duct at connections to air terminal units, at runouts to grilles and diffusers, at points of round to round flexible connections (see also "Flexible Connections") and at other locations indicated or required.

B. Prohibited Material: Do not use single wire helix ducting with vinyl or plastic liner of any type.

C. Factory Duct Non-corrosive Environments: Woven fiberglass fabric impregnated with vinyl or neoprene clamped in a continual helix of aluminum or cold rolled steel. U.L. listed for Class 1 duct, compliant with NFPA 90A and 90B, pressure rated to 12" w.g., equivalent to:

D. Non-insulated: Wiremold 57; Flexmaster Type N145

E. Insulated: Flexmaster Type 4; Thermaflex M-KC

F. Installation: Follow manufacturers instructions. Use stainless steel or nylon band clamping rings. In general, do not use lengths in excess of 3 feet. Make bends only in long radius format. Support duct to avoid droops and kinks.

2.8 MISCELLANEOUS DUCTWORK MATERIALS:

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Runout Fittings: Runout fittings shall be used to make round to rectangular duct connections. Use 45° time and a half square to round fittings. Provide with locking quadrant dampers where balance is involved. Provide with insulation guard where insulated duct is involved.

C. Duct Sealing Compound: Duct sealing compound shall be 3M brand number EC-750 or Duro-Dyne S-2. This material shall be used in making up duct joints or in water proofing, caulking plenums, etc.

D. Acoustical Lining: Acoustical lining in ducts shall be 1" thick, 1-1/2 pound density, coated, flexible glass fiber type, set in adhesive and impaled on weld studs spaced not more than 12" on centers and secured with lock washers. Airstream surface faced with black coated matte. Acoustical lining shall completely line the ducts. Lining shall have a fire and smoke hazard rating not exceeding 20-50-50. Owens-Corning, Johns-Manville, Certainteed.

E. All joints, edges and/or surface breaks in the coating of the acoustical lining shall be pointed up to a smooth surface with adhesive.

F. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives and Duct Thermal Insulation".

G. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.

H. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement (type applicable for fabrication/ installation detail) as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

I. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

PART III - EXECUTION

3.1 INSPECTION:

A. General: Examine areas and conditions under which metal ductwork and plenum are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF METAL DUCTWORK:

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary, the required area shall be maintained. All of these changes, however, must be approved and installed as directed at project. During the installation, the open ends of ducts shall be protected to prevent debris and dirt from entering.

B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

D. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures. Maintain clearances above of and in front of electrical panels.

E. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.

1. Where ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate, in accordance with requirements of Section "Firestopping".

F. Ducts At Structural and Architectural Penetrations: Where ducts are shown connecting to or passing through concrete, gypsum board, masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2-1/8" galvanized angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron. Round high velocity ducts in vertical chases shall be supported with rolled angle rings. Close openings between duct and structure.

G. Cross Breaking: Rectangular sheet metal ducts shall be cross broken on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles; the center of cross break shall be of the required height to assure surfaces being rigid.

H. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

I. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

1. Related to final installation cleanliness, damp wipe all ductwork on installation.

3.3 INSTALLATION OF DUCT LINER:

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

As indicated on the drawings, supply and return air ductwork shall be lined with acoustical insulation.

3.4 INSTALLATION OF FLEXIBLE DUCTS:

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 3'-0" extended length. No elbows allowed.
B. Installation: Install in accordance with Section III of SMACNA's "HVAC Duct Construction Standards, Metal and Flexible".

3.5 HANGERS AND SUPPORTS:

A. It is essential that all ducts shall be rigidly supported. Hangers for low velocity ducts up to 18" in width shall be placed on not more than 10' centers.

Low velocity ducts 19" through 35" in width and greater shall be supported on not more than 5' centers. Where vertical ducts pass through floors or roofs, heavy supporting angles shall be attached to ducts, and to structure. Angles shall be of

sufficient size to support the ductwork rigidly and shall be placed on at least two sides of the duct.

B. Construct hangers for rectangular ductwork from galvanized iron l" x 1/16". Hangers shall extend down the sides of rectangular ducts the full depth of the duct and shall be bent underneath the duct 2". Hangers shall be secured to the duct using sheet metal screws or rivets of appropriate sizes on 6" centers, but not less than two screws in the side and one in the bottom of each hanger.

C. For rectangular ducts 36" and greater in width construct hangers from galvanized iron 1-1/2" x 1/16". Hangers shall be installed and secured to duct as described in Paragraph B.

3.6 CONNECTIONS: Connections of high velocity supply and exhaust ducts, fittings, and high velocity mixing boxes shall be made airtight by coating joints with Minnesota Mining Co. Mastic, Type EC-800, Benjamin Foster, Sheet Metal Products Co., or approved equal, before joining, and then sealing the joint with one layer of "Glass-Fab" reinforcing tape set in a coating of the above compound. Tape and sealant shall not exceed a flame spread of 25 or a smoke development of 50.

3.7 WELDED JOINTS: Welded ductwork shall have either an angle or a piece of 1/8" steel bar behind each weld to allow laying of a neat and continuous bead.

3.8 AESTHETIC LAYOUTS: Contractor shall locate all diffusers, grilles and other exposed items in such a manner as to fit symmetrically in any grid system or other aesthetic architectural or lighting pattern. Refer to reflected ceiling plans and electrical lighting layouts for additional information. Provide duct offsets or extensions as required to make a proper installation.

Close or cap all duct ends. Use auxiliary blower with air flow meter to establish a duct pressure equivalent to the duct pressure class. Inspect all joints in duct system and seal all identifiable leaks.

3.11 FIELD QUALITY CONTROL:

A. Leakage Tests: After each duct system which is constructed for duct classes over 3" is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Air leaks which are in excess of that required to bubble the soap suds (that is, actually blow the suds away) shall be sealed by additional taping and caulking to reduce the leakage to a rate not to exceed slow bubbles forming. Repair leaks and repeat tests until total leakage conforms with Chart of Figure 4-1, Seal Class A, Leakage Class 3 for round/oval, 6 for rectangular.

3.12 ADJUSTING AND CLEANING:

A. Clean ductwork internally of dust and debris, as follows: Before the ceilings are installed, with filters in place, operate the fans at full capacity to blow out dirt and debris from ducts. If it is not practical to use the main supply blower for this test, the ducts may be blown out in sections by a portable fan.

B. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

C. Balancing:

1. Refer to Division 15 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. However, the

Sheet Metal Contractor shall participate fully in this work. Seal any leaks in ductwork that become apparent in balancing process.

2. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor and his subcontractors shall make any changes necessary to obtain the specified conditions.

END OF SECTION 15890

SECTION 15910 - DUCTWORK ACCESSORIES

PART I - GENERAL

1.1 RELATED DOCUMENTS:

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

B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY:

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork accessories required for project include the following:

1. Dampers.

   a. Low pressure manual dampers.
   b. Control dampers.

2. Turning vanes.
3. Duct hardware.
4. Duct access doors.

C. Refer to other Division-15 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of General Conditions.

1.5 REFERENCES:

A. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".

4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Protection: Protect shop-fabricated and factory-fabricated accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store accessories inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART II - PRODUCTS

2.1 DAMPERS:

A. Control dampers for balance only where tight shutoff is not critical are to be furnished and installed by this Section. 6" galvanized blade, poly foam blade seals, flexible metal jamb. Parallel blade operation.

1. Ruskin CD-35
2. Greenheck

2.2 TURNING VANES: Turning vanes shall be installed in all square elbows. Turning vanes shall be single blade. Turning vane spacing shall be per SMACNA. Each blade shall be tack welded or crimped to the carrier frame to prevent rattling.

2.3 DUCT HARDWARE:

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, cover, for instrument tests. Ventlok No. 699 closures shall be provided and installed for each test hole, with sufficient neck length to penetrate the insulation.

2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork. (Bare duct - Ventlok 620, 635; Insulated duct - Ventlok 627, 628, 637, 638, 629.)

3. Provide and install Young Regulator Bowden cable system for all dampers located above non- lay in ceilings. All hand damper remote regulators are to be routed back to an accessible location near a ceiling access door (located near a VAVR terminal box). Regulators are not to be exposed on the ceiling. Clearly label which damper the regulator serves.

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.

2.4 DUCT ACCESS DOORS: Doors shall be 2" narrower than the duct width by 24" up to a maximum of 24" x 24". Duct access doors shall be furnished for all fire damper links, manual controllers and adjustable balancing devices. Duct access doors for all ductwork (except low pressure ductwork) shall be: Bolted access door, oval shaped constructed of an outer door connected to a an inner plate by spring loaded carriage bolts with wing handles. Inner plate to have cellular spounge gasket for leak free operation up to 20"wg. The door shall have permanently bonded polyester insulation.

PART III - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES:

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install hand operated volume dampers at locations and of sizes shown. Volume dampers shall be controlled by heavy duty locking quadrants mounted on the outside of the duct. Where ducts are insulated, the damper rod shall be extended and the operator shall be mounted on the outside of the insulation. Butterfly dampers may be constructed by the Sheet Metal Contractor. All multi-blade hand dampers shall be the product of one of the manufacturers listed in the Contract Documents. All operator fittings shall be heavy duty commercial grade.

C. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems, and elsewhere as indicated.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL:

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.4 ADJUSTING AND CLEANING:

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

1. Label access doors in accordance with Division-15 section "Mechanical Identification".

2. Final positioning of manual dampers is specified in Division- 15 section "Testing, Adjusting, and Balancing".

3. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 15910

SECTION 15930 - AIR TERMINAL UNITS

PART I - GENERAL

1.1 RELATED DOCUMENTS:

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

B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY:

A. Extent of air terminals work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of air terminals specified in this section include the following:

1. Air Control Valves

a. Single Duct VAV Cooling only.
b. Dual Duct VAV Cooling/Heating.

C. Refer to other Division-15 sections for external insulation of air terminals; not work of this section.

D. Refer to other Division-15 sections for testing, adjusting and balancing of air terminals; not work of this section.

E. Refer to other Division-15 sections for temperature controls which are to be furnished by others but installed as work of this section.

F. Refer to other Division-15 sections for temperature controls for air terminals; not work of this section.

G. Refer to Division-16 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on air terminals. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

1. The Installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the contractor.

2. All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit ladder-type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.

D. Maintenance Data: Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and maintenance data in maintenance manual; in accordance with requirements of Division 15995.

1.5 REFERENCES:

A. Codes and Standards:

1. ARI Compliance: Provide air terminals which have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal.

2. NFPA Compliance: Construct air terminals using acoustical and thermal insulations complying with NFPA 90A "Air Conditioning and Ventilating Systems".

3. International Building Code/International Mechanical Code: Comply with all sections pertaining to mechanical work.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver air terminals wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.

B. Store air terminals in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART II - PRODUCTS

2.1 SINGLE DUCT VARIABLE VOLUME COOLING ONLY:

A. General: Provide factory-fabricated and tested air terminal as indicated, selected with performance characteristics which match or exceed those indicated on the schedule. Vendor/Contractor to verify count and arrangement.

B. Construction: Factory fabricate VAV damper into a single cabinet. Construct cabinet of 22 gauge or heavier galvanized steel with a 1" thick acoustical lining. Construct VAV damper of air-tight, quarter turn design with shaft supported in sintered bronze or nylon bearings.

C. Controls: Pressure independent. ATC contractor shall furnish box controllers and accessories and make field installation. Include a cross flow pressure sensor factory mounted with each box.

D. Acceptable Manufacturers:

1. Titus
2. Krueger
3. Price

2.2 DOUBLE DUCT VARIABLE VOLUME COOLING/VARIABLE VOLUME HEATING:

A. General: Provide factory-fabricated and tested air terminal double duct unit as indicated, selected with performance characteristics which match or exceed those indicated on the schedule. Each box shall be comprised of 2 single VAV boxes, sized as indicated, and connected together to discharge into a full size common plenum at least 12" in length. Transition to required duct runout size as shown on drawings downstream of 12" long plenum. Vendor/Contractor to verify count and arrangement.

B. Construction: Factory fabricate VAV dampers into a single cabinet. Construct each cabinet section of 22 gauge or heavier galvanized steel with a 1'-0" thick acoustical lining and 1" long, 1" thick acoustically lined extension plenum. Construct VAV damper of air-tight, quarter turn design with shaft supported in sintered bronze or nylon bearings.

C. Controls: Furnish and installed by Division 15, Controls Sections.

1. Pressure independent digital electronic controller.
2. VAV damper control, normally closed, (NC), cooling.
3. VAV damper control, normally open, (NO), heating.

D. Acceptable Manufacturers:

1. Titus
2. Krueger
3. Price

PART III - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF AIR TERMINALS:

A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.

B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer. Protect electrical clearances. Protect access to controls.

C. Duct Connections: Connect ductwork to air terminals in accordance with Division-15 ductwork sections.

3.3 FIELD QUALITY CONTROL:

A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak-tight.

B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

3.4 CLEANING:

A. Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturers touch-up paint.

END OF SECTION 15930

SECTION 15940 - AIR OUTLETS AND INLETS

PART I - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

B. Types of outlets and inlets required for project include the following:

1. Ceiling air diffusers and grilles.
2. Wall registers and grilles.

C. Refer to other Division 15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

D. Refer to other Division 15 sections for balancing of air outlets and inlets; not work of this section.

E. Refer to other Division sections for louvers, not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

1. The Installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

2. All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Samples: 3 samples of each type of finish furnished. Provide Color sample for Architect's selection.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of General Conditions.

1.5 REFERENCES:

A. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".

2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".

4. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.

5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART II - PRODUCTS

2.1 GRILLES AND DIFFUSERS:

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

D. Adjust all grilles and diffusers to fit neatly in the room ceiling pattern. Set final locations per architectural reflected ceiling plans.

E. Volume Control Dampers: Provide duct mounted dampers of the externally adjustable opposed blade type where more than one grille or register is on a common duct. Provide access to each damper adjustment.

F. Manufacturers: Subject to compliance with requirements, provide grilles and diffusers of one of the following:

1. Krueger
2. Titus
3. EH Price

G. Types: Provide grilles and diffusers of type, capacity, and with accessories and finishes as listed on grille and diffuser schedule and as specified herein.

H. Grilles and Diffusers:

1. Ceiling Supply Diffuser (S-1): Krueger Series 1400, square face, round neck, four-way deflection, anti-smudge design, removable inner core, all steel construction, appropriate mounting frame, white baked enamel finish, size as indicated on drawings.

2. Perforated Return Register (R-1): Krueger Series 6490. Concealed hinge frame, sponge rubber gasket, white baked-on enamel, size as indicated on drawing.

3. Sidewall Return Register (R-2): Krueger Series S480H. Heavy Duty steel construction, appropriate mounted frame, ½” blade spacing, blades on 35 deg. angle unless otherwise shown on drawings, sponge rubber gasket, size as indicated on drawings. White baked enamel finish.

PART III - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction

"Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

END OF SECTION 15940

SECTION 15950 - MECHANICAL CONTROL SYSTEMS

PART I - GENERAL

1.1 RELATED DOCUMENTS:

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

B. Division-15 General Mechanical Requirements sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. Extent of control systems work required by this section is indicated on drawings and schedules, and by requirements of this section.

1. See following sections for types of Control Systems included as a part of this section. See electrical, automation, etc.

2. Control sequences are specified in this section under: "Sequence of Operation".

B. Refer to Division-16 sections for the following work.

1. Power supply wiring from power source to power connection on controls and/or unit control panels. Includes starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

2. Interlock wiring between electrically-operated equipment units; and between equipment and field-installed control devices.

a. Interlock wiring specified as factory-installed is work of this section.

C. Provide the following electrical work as work of this section, complying with requirements of Division-16 sections:

1. Control wiring between field-installed equipment, controls, indicating devices, and unit control panels. All control wiring shall be in conduit.

2. 120 volt service required by control systems.

D. Participate in "System Commissioning, Testing and Balancing".

E. Setup, confirm and calibrate control functions of existing dual duct VAV terminal boxes and associated controls that serve areas where new ductwork, distribution and remodel work is being performed.

F. Relocate existing room temperature sensors to new locations as shown and described on the drawings.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of electric control equipment, of type and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. This project shall be bid using TAC Controls furnished and installed by Utah Yamas Controls.

B. Installer’s Qualifications: Firms and workmen specializing and experienced in electric control system installation for not less than 5 years. Installer shall be under the direction of the controls manufacturer (Utah Yamas Controls).

C. Codes and Standards:

1. Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.

2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.

3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

4. Comply with NEPA 70, "National Electric Code" for all electrical installation.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.

B. Shop Drawings: Submit shop drawings for each control system, containing the following information:

1. Schematic flow diagram of system showing VAV terminal boxes, and control devices.

2. Label each control device with setting or adjustable range of control.

3. Indicate all required electrical wiring. Clearly differentiate between portions of work that are factory-installed and portions to be field-installed. Note contract responsibility to provide complete system regardless of delegation. Completely interface with and show existing installation in the Administration building.

4. Provide details of faces of control panels, including controls, instruments, and labeling.

5. Include verbal written description of sequence of operation. Confirm correct function of proposed sequences.

C. Samples: Submit sample of each type of proposed thermostat cover.

D. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Section 15195.

1.5 DELIVERY, STORAGE, AND HANDLING: Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

1.6 INSTRUCTION OF OWNER'S PERSONNEL:

A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.

B. Instruction to cover purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.

C. Prepare an outline of information to be conveyed, list materials available for reference. Submit to Architect along with a proposed schedule of instruction. Schedule to allow individual time for each trade and each system.

D. Convey information in formal classroom session. Instructors to include qualified contractor personnel and sales representatives for each major piece of equipment. Go from the classroom to the actual location to graphically illustrate concepts discussed.

1.7 WARRANTIES:

A. As part of the overall project warranty, furnish individual manufacturer warranties for each piece of equipment for a period of not less than one year from date of Owner's beneficial use (substantial completion).

B. Warrant the overall assembly of equipment, materials and labor comprising these systems.

1.8 CLEANING AND LUBRICATION: All instruments, control panel and control piping shall be thoroughly cleaned before final acceptance. Provide any required lubrication for all furnished equipment.

1.9 TESTING AND ADJUSTING OF SYSTEM:

A. During the system commissioning, testing and balancing of the new and remodeled systems, have a controls representative(s) present and available to interpret and adjust the new and existing controls as needed. Demonstrate and report the integrity and accuracy of each function and control point.

B. At the termination of the testing period, the Controls representative shall spend one working day instructing the Owner's operating personnel in the control system operation, and one working day checking each system for day-night and manual override with the Owner's operating personnel on each air system. A complete operating booklet shall be provided and used during the training period. Schedule this training with the Owner and Mechanical Contractor.

Since system performance is partly a function of climatic conditions, the Controls contractor shall be available during the changing seasons of the warranty period to make further adjustments and modifications if required. A final complete check of all systems shall be made at the conclusion of the one year warranty period.

PART II - PRODUCTS

2.1 POWER SUPPLY:

A. Furnish complete power supply for all box controllers at appropriate voltage and in adequate capacity. Provide multiple power supply devices, mount conveniently in custodial closets or ceiling spaces as directed. Load power supply units to no more than 70 percent of nameplate capacity. Where available connect to the existing low voltage transformer power supply. Do not overload existing transformers. If adequate transformer power is not available provide new.

1. Run all power wiring in conduit, neatly arranged and coordinated with other trades.

2. Group boxes served by each power supply unit in proximity, provide permanent mounted schedule of boxes served by each power supply.

2.2 COMMUNICATIONS CONDUCTORS:

A. Connect each and every VAV box controller back to the Central Direct Digital master controller with required conductors) shielded cable. (Beldon #18 gauge "Beldfoil 8760 or equivalent). Avoid common conduit with AC voltage or inductive loads. All in accordance with National Electric Code, conductors in conduit (3/4" minimum).

2.3 CONTROL WIRING:

A. In concealed locations above lay-in ceilings low voltage conductor may be installed without conduit. Low voltage conductor shall be UL listed Article 725 Plenum Cable. Install the cable parallel to building walls.

1. In all other building areas, ie., electrical rooms, mechanical rooms, server rooms, above “hard” ceilings, within walls, etc., all control wiring shall be installed in

conduit per National Electric Code. Installation shall be square with the walls of the buildings.

2. Number and code all wiring.

2.4 DAMPERS:

C. Provide damper operators with motors of proper size, so that the motors will operate against the static pressure of the systems. Provide each damper motor with a bracket for attaching to ductwork or VAV terminal box. Modulating motors where indicated shall be provided with integral stops for both minimum and maximum stop.

PART III - CONTROL SEQUENCES

3.1 GENERAL:

A. Provide control systems to manage and manipulate mechanical equipment in a functional and energy conserving way.

3.2 CENTRAL CONTROL AND MONITORING SYSTEM:

A. Connect all new VAV box controllers to existing communications buss.

3.3 ROOM/SPACE TEMPERATURE CONTROL SEQUENCES:

A. VAV COOLING: Each room/space VAV box (cooling only) shall be controlled by a DDC controller fed through the central control panel, including a VAV box inlet flow sensor and outlet temperature sensor. This will allow for remote monitoring and remote changing of unit parameters.

When the room temperature is above the setpoint of the unit controller as sensed by the space sensor, the VAV box will be open.

As the room temperature drops to setpoint, the VAV box modulates to its minimum. This minimum shall be fully automatically adjustable and set as called for on the Drawings.

B. DUAL DUCT VAV COOLING/VAV HEATING: Each room/space dual duct VAV cooling/VAV heating box shall be controlled by a DDC controller fed through the central control panel, including an inlet flow sensors in the cold box and in the hot box and outlet temperature sensor. This will allow for remote monitoring and remote changing of parameters.

When the room temperature is above the set point of the VAV box controller, the VAV cooling valve will be open. As the space temperature drops the cooling valve modulates to its minimum. Should the space temperature drop below set point the cooling box modulates closed from its minimum while the heating box modulates open. This minimum is automatically adjustable and shall be set as called for on the drawings.

END OF SECTION 15950

SECTION 15955 - ELECTRIC CONTROL SYSTEMS

PART I - GENERAL:

1.1 RELATED DOCUMENTS: See Section 15950.

1.2 DESCRIPTION OF WORK:

A. Electric control functions and systems indicated on the drawings and specified herein.

1.3 QUALITY ASSURANCE: See Section 15950.

1.4 SUBMITTALS: See Section 15950.

1.5 DELIVERY, STORAGE AND HANDLING: See Section 15950.

1.6 INSTRUCTION OF OWNER'S PERSONNEL: See Section 15950.

1.7 WARRANTIES: See Section 15950.

1.8 CLEANING AND LUBRICATION: See Section 15950.

1.9 TESTING AND ADJUSTING OF SYSTEM: See Section 15950.

PART II - MATERIALS AND METHODS

2.1 ELECTRICAL POWER SUPPLY:

A. Obtain power from Division 16 distribution panel. Furnish appropriate circuit breakers and extend conduit and wiring assigned to this division.

B. Furnish and install UL listed voltage reducing transformers required for this work. Size transformers to see no more than 70 percent of rated capacity at full load. Use industrial quality "machine tool" grade transformers.

C. Make all electrical installations in conformance with the National Electrical Code (current edition) and in accordance with Division 16.

D. Use same product lines for similar devices as used by electrician to result in a coherent project.

E. Control Wiring:

1. In concealed locations above lay-in ceilings low voltage conductor may be installed without conduit. Low voltage conductor shall be UL listed Article 725 Plenum

Cable. Install the cable parallel to building walls.

2. In all other building areas, ie., electrical rooms, mechanical rooms, server rooms, above “hard” ceilings, within walls, etc., all control wiring shall be installed in conduit per National Electric Code. Installation shall be square with the walls of the buildings.

3. Number and code all wiring.

F. Use no wire smaller than 16 gauge, no conduit smaller than 1/2".

END OF SECTION 15955

SECTION 15970 - DIRECT DIGITAL CONTROL SYSTEMS (DDC)

PART I - GENERAL:

1.1 RELATED DOCUMENTS: See Section 15950.

1.2 DESCRIPTION OF WORK:

A. Provide control system related materials and installation related to Mechanical controls.

1.3 RELATED SECTIONS

A. Section 15950 – Mechanical Control Systems, Section 15955 Electric/Electronic Control Systems

B. Division 15 – Sections 15995 related to Testing and Balancing.

C. Division 15 - See mechanical work and equipment required for installation of Building Management Control System including but not limited to –

1. VAV and DVAV terminal boxes

D. Division 16 - Electrical work for power sources for panels and control equipment, providing of motor starters and disconnect switches.

E. Division 1 – General Requirements.

F. Division 15000 – General Mechanical Requirements.

G. To include all components, materials and installation covered by Section 15955, Electric Control Systems and to be fully integrated with the same.

H. To include all control wiring initiating with power from the distribution panel(s) at line voltage (provide circuit breaker) and extending to transformers, devices, components, etc. which comprise a part of the system.

1.4 QUALITY ASSURANCE: See Section 15950.

A. This specification wording is based on T.A.C product line from Utah Yamas Controls.

1.5 SUBMITTALS: See Section 15950.

1.6 DELIVERY, STORAGE AND HANDLING: See Section 15950.

1.7 INSTRUCTION OF OWNER'S PERSONNEL: See Section 15950.

1.8 WARRANTIES: See Section 15950.

1.9 CLEANING AND LUBRICATION: See Section 15950.

1.10 TESTING AND ADJUSTING OF SYSTEM: See Section 15950.

1.11 OPEN PRICING: Vendors shall make detailed cost breakdowns of this work available to Owner during period of evaluation of the project to aid in identifying costs and benefits of this system.

PART II - PRODUCTS

2.1 ELECTRIC DEVICES: See Section 15955.

2.2 TEMPERATURE SENSORS

A. Temperature Sensors: Temperature sensors shall be linear precision elements with ranges appropriate for each specific application. All ASC room sensors shall provide for direct connection and access to the LonTalk network. Sensors that provide access only to their connected controller shall not be acceptable"

B. Digital room sensors shall have LCD display, day / night override button, and set point slide adjustment override options. The set point slide adjustment shall have software limits by the automation system to limit the amount of temperature setpoint adjustment.

2.3 VAV/DVAV TERMINAL AIR CONTROL BOX ACTUATOR:

A. The terminal box air valve shall be positioned by a dual synchronous 3-point floating motor provided by the contractor. The motor shall operate the damper from full closed to full open no faster than 4 minutes and no slower than 8 minutes. Motor gears and housing shall be metallic to insure long motor life.

B. The motor assembly shall slip over the damper shaft and lock into position using knurled set screws. Rotation shall be adjustable from 45° to 90°. The motor frame shall be mounted to the box with no more than three screws. To minimize maintenance costs over the life of the installation, the gear motor shall be a separate component. Motors which are an integral part of the controller shall not be accepted.

2.4 APPLICATION SPECIFIC CONTROLLERS (ASC)

A. Each Application Specific Controller (ASC) shall operate as a stand-alone LonMark® compliant controller capable of performing its specified control responsibilities independent of other controllers in the network. Each ASC shall be a minimum 16-BIT microprocessor based, multi-tasking, multi-user, real time digital control processor.

B. Each ASC's application must comply with LONMARK® interoperability profile guidelines.

C. Flash memory reload or updating of an existing control algorithm shall be completed over the network.

D. Network access shall be accomplished at the ASC room sensor or the ASC. System node access shall be available from connecting to the room sensor jack. Systems that do not have a system access jack from the room sensor shall provide a dedicated network jack next to each room sensor.

E. Controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog and digital outputs shall be industry standard signals such as 0-10V and 3-point floating control allowing for interface to a variety of industry standard modulating actuators. The ASC inputs and outputs shall consist of industry standards types. Inputs shall be electrically isolated from outputs, communications and power. All inputs shall be provided with an auto-calibrate function to eliminate sensing errors.

F. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the network is not acceptable.

G. The ASC must be mounted remotely from the room sensor. ASC's, that are wall mounted with integral room sensors, are not acceptable.

H. The control program shall reside in the ASC. The application program configuration information shall be stored in non-volatile memory with no battery back up.

I. After a power failure the ASC must run the control application using the current setpoints and configuration. Reverting to default or factory setpoints are not acceptable.

PART III - EXECUTION

3.1 COMPLETE SYSTEM:

A. Integrate into all controls into the Control System. Provide all controls and related functions, with all power and communications wiring, with room thermostats, actuators, dampers, etc. Make a complete installation of Building Automation and Temperature Control systems. Coordinate between trades and adapt to actual job site conditions.

B. Note that the terminal box controller is to provide a "pressure independent" function for any terminal box provided for this project.

C. Participate in the checkout and commissioning and shake out of all of the mechanical systems. Provide complete and detailed checkout and testing of all controls and control sequences. Provide thermal rise trend recording and logs during system testing and shake out.

D. Install systems as detailed on drawings and in accordance with instructions received with temperature control system components.

E. Mount Damper actuators and actuator linkages external of airflow.

F. Provide E-Bus and LON Bus cable and other certified system compatible control equipment.

G. Update graphics and programming at the central campus front end computer. Interface new and remodeled with existing system.

3.2 DATA CONTROL AND GRAPHICS SUMMARY

A. General
1. List of hardware points for each DDC controller appears on Mechanical Drawings. Graphics showing these points, along with appropriate pseudo points (i.e. set points, etc.) shall be incorporated into operational graphics.
2. Provide software graphics and programming required to accomplish detailed sequence of operations.

3.3 CONTROL SEQUENCES:

A. The sequences of control for the DDC system shall be equivalent to those specified for the

base bid system with the added benefits of programmable algorithmic control.

B. Fully describe the sequences in the submittals.

C. Fully document all work by shop drawing and product bulletin submittal, work from reviewed drawings, maintain record documents during installation, provide a complete "As-Built" document set in Autocad 2010 at completion.

3.4 SYSTEM ACCEPTANCE:

A. GENERAL: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Architect requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.

B. FIELD EQUIPMENT TEST PROCEDURES: DDC controls panels shall be demonstrated via a functional end to end test. Such that:

1. All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operations verified.

2. All analog input channels shall be verified for proper operation.

3. All digital input channels shall be verified by changing the state of the field device and observing the appropriate change of displaying value.

4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.

5. Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.

6. Selected time and setpoint schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.

C. WORKSTATION TEST PROCEDURES: The system workstation test procedures shall be as follows:

1. Communication with each DDC control panel shall be demonstrated.

2. Operator commands will be explained and demonstrated.

3. Control sequences shall be demonstrated for proper operation.

4. All available system reports and logs shall be demonstrated at the system workstation.

5. Correct system start-up and shutdown procedures shall be demonstrated.

6. All controllers shall be demonstrated to operate in a standalone mode.

D. AS-BUILT DOCUMENTATION: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply "6" complete 11x17 as-built drawing sets, together with Auto Cad diskettes to the Owner.

E. OPERATION AND MAINTENANCE MANUALS: Submit two copies of operation and maintenance manuals. Include the following:

1. Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals, and any miscellaneous components used in the system.

2. An operator's manual which will include detailed instructions for all operations of the system.

3. An operator's reference table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.

4. A programmer's manual which will include all information necessary to perform programming functions.

5. A language manual which will include a detailed description of the language used and all routines used by the system.

6. Flow charts of the control software programs utilized in the DDC system.

7. Flow charts of the custom software programs utilized in the DDC system as approved.

8. Complete program listing file and parameter listing file for all programs.

9. A copy of the warranty.

10. Operating and maintenance cautions and instructions.

11. Recommended spare parts list.

END OF SECTION 15970

SECTION 15995 - SYSTEM COMMISSIONING, TESTING AND BALANCING

PART I - GENERAL

1.1 GENERAL CONDITIONS:

A. Work of this section shall be subject to the requirements of the General Conditions of this contract, the General Mechanical Requirements, General Electrical Requirements and other sections where this work shares a responsibility.

B. System commissioning and startup of the mechanical systems shall be the responsibility of the Mechanical Contractor and his subcontractors with the participation of the Electrical Contractor related to electrical work and the General Contractor related to general construction items.

C. Testing and Balancing shall be the responsibility of the Mechanical Contractor under the direction of the General Contractor with the full participation of all of the mechanical and electrical trades employed on the project and shall include the participation of an independent testing and balance contractor to coordinate all elements of the work and to perform special technical services outlined herein.

1.2 SYSTEM COMMISSIONING - EXTENT OF WORK:

A. The work required by this section includes but is not necessarily limited to the following:

1. The pre-startup inspection of all systems and subsequent correction of any incorrect items.

2. The initial first run inspections.

3. System operations inspection.

B. The intent of this work is to provide for proper installation, startup, service and operation of the mechanical systems in preparation for system balancing.

C. Repair, replacement or adjustment of each item shall be performed by the installing contractor.

D. Involves all new construction and those elements of existing construction which are affected by this project.

1.3 TESTING AND BALANCING - EXTENT OF WORK:

A. This work incorporates a confirming checkout of construction work, an individual component activation and an overall system activation into one work program which shall serve as the transition period from the Contractor's job to Owner's facility.

B. The TAB Contractor shall be skilled in the operation and manipulation of systems and in the direction of parties involved in the work.

C. Conduct and participate in the startup and shakedown of all mechanical systems installed and modified in this contract; test adjust and balance these systems to obtain optimum performance at a level which minimizes the required energy input, prepare and submit a complete report of work done and the final system condition obtained, participate in the

instruction of Owner's personnel in the proper operation of systems and equipment.

D. Involves all new construction and those elements of existing construction which are affected by this project.

1.4 QUALIFICATIONS OF SYSTEM COMMISSIONING AND TAB TEAM:

A. Representatives of the General Contractor, Mechanical Contractor, etc., and Electrical Contractor shall be available on a daily basis through the commissioning and adjustment period. These men shall be experienced journeymen with prior experience in system operation and with specific experience on the construction of this project.

B. Balancing shall be done by an independent firm specializing in this work. A definition of independent shall mean the firm is not associated with any engineering, contracting, or manufacturing firm and derives its income solely from testing, adjusting and balancing mechanical systems. Approved firms to do this work are Barnett, Inc., Payson, Utah, or BTC Services, Salt Lake City, Utah or Certified Testing and Balancing, Inc, Riverton, Utah.

C. The balancing work shall be performed by the same firm having total responsibility for the final testing, adjusting and balancing of the entire system. A principal of the firm shall be directly involved in the project.

D. The independent testing and balancing firm shall furnish all necessary tools, scaffolding and ladders that are required and shall provide all required instruments, take all readings and make all necessary adjustments.

E. After all tests and adjustments are made a detailed written report shall be prepared and submitted for review, and shall bear the signature of the professional supervising the work. Final acceptance of this project will not be made until a complete and satisfactory report is received. Furnish two copies of the report.

PART II - EXECUTION, SYSTEM COMMISSIONING

2.1 PRE-STARTUP INSPECTION:

A. The pre-startup inspection of all systems shall provide for verifying that each piece of equipment is properly installed and prepared for startup.

B. All pertinent items shall be checked, including but not necessarily limited to the following:

1. Control system is in operation.

2. All interlocks are wired and verified.

3. All controls have been connected and verified.

4. Dampers and operators are properly installed and operating.

5. All ductwork is installed and connected.

6. All other items necessary to provide for proper startup.

PART III - EXECUTION - TESTING AND BALANCING

3.1 TOTAL MECHANICAL SYSTEM BALANCE:

A. The mechanical systems balance involves elements of the work of the General Contractor, the Electrical Contractor, the Mechanical Contractor, the Sheet Metal Contractor and the Controls Contractor. Total system balance requires that all elements be not only individually correct, but also correct as a composite system. Therefore, participation of all parties shall be required in the test and balance procedure.

B. Prior to beginning work, a written description of the anticipated sequence of action shall be submitted to the Architect/Owner for review and comment.

C. The testing and balance specialist shall review the contract drawings during the bid period and shall advise the Architect of any modifications to the layout which may be needed to facilitate the balance procedure. Modifications will be incorporated into the contract by Addendum during the bidding period.

3.2 AIR SYSTEMS BALANCE:

A. Before any adjustments are made, check the existing air handling unit for such items as dirty filters, duct leakage, filter leakage, damper leakage, equipment vibrations, correct damper operations, etc. Report any observed adverse conditions to the Owner, for their correcting and or repairing of any existing conditions that will adversely affect the proper balancing of the systems.

B. Adjust all fan systems, major duct sections, registers, diffusers, etc., to deliver design air quantities within +5%. Individual air outlets, when one of three or more serve a space may have a tolerance of 10 percent from the average. Design static pressure is based on filters approximately 50% loaded with dirt. Pressure drop across filters during balancing shall be simulated to that condition. After balancing is completed check motor amperage with the filters clean.

C. Adjust supply, exhaust and recirculation air systems towards air quantities shown on drawings. Establish a proper relationship between supply and exhaust. Follow proportional balance procedures outlined by AABC and/or SMACNA for such work.

D. Distribution system shall be further adjusted to obtain uniform space temperatures free from objectionable drafts and noise within the capabilities of the system.

3.3 CONTROL SYSTEMS: The Testing and Balancing Contractor shall go through the entire control system with the Controls Contractor verifying proper operation of each and every device and the proper function of each system. Certify such effort in the report.

A. Upon request, a representative of the balancing firm performing the work shall demonstrate fluid flow quantities shown in the report by reading back outlets or terminals selected specifically or at random by the Design Engineer. It is understood that the operating mode of the system shall be the same for read-back as it was during balancing.

3.4 REPORT:

A. Provide a bound report in four copies containing a general information sheet listing instruments used, method of balancing, altitude correction, and manufacturer's grille, register and diffuser data.

B. Provide equipment data sheets listing make, size, serial number, rating, etc. of all mechanical equipment including fans, air controllers, pumps, motors, starters and drives. Operating data shall include rotational speed, inlet an outlet pressures, pressure drop across filters, coils, an other system components, pump heads, and measured motor current and voltage.

C. Balancing data sheets shall indicate the required and actual CFM of all supply, return and exhaust outlets or inlets, and be totaled and summarized by systems.

D. Include a reduced set of contract drawings with outlets marked for easy identification of the assignation used in the data sheets.

E. Note any abnormal or notable conditions not covered in the above.

F. Keep a daily log of all work performed, with a list of work scheduled for each day and the workers on the job.

END OF SECTION 15995

SECTION 16051 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

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B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
1. Minimum Metal Thickness:
a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Calpico, Inc.
b. Metraflex Co.
c. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

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3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors [2 inches (50 mm)] <Insert dimension> above finished floor level.

G. Size pipe sleeves to provide [1/4-inch (6.4-mm)] <Insert dimension> annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION 16051

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SECTION 16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.3 SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

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B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors, unless otherwise indicated.

B. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus on insulated spacers 1 inches (25 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.
   1. Busway Supply Circuits: Install insulated equipment grounding conductors from grounfing bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

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E. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
   1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

C. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install [tinned]bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal , and at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.

B. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
   2. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

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C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060

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SECTION 16073 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.

B. Related Sections include the following:
   1. Division 16 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. 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.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

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B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Wesanco, Inc.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   5. Channel Dimensions: Selected for applicable load criteria.

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 A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Cooper B-Line, Inc.; a division of Cooper Industries.
         2) Empire Tool and Manufacturing Co., Inc.

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3) Hilti Inc.
4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

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. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

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 scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: 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.
1. Secure raceways and cables to these supports with single-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 NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

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1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 9 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 16073

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SECTION 16074 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

B. Related Sections include the following:
1. Division 16 Section "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
1. Site Class as Defined in the IBC: as required by the Structural Engineer.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: as required by the Structural Engineer.
   a. Component Importance Factor: as required by the Structural Engineer.
   b. Component Response Modification Factor: as required by the Structural Engineer.
   c. Component Amplification Factor: as required by the Structural Engineer.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): as required by the Structural Engineer.
4. Design Spectral Response Acceleration at 1.0-Second Period: as required by the Structural Engineer.

1.5 SUBMITTALS

A. Product Data: For the following:
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

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a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

1.6 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Structural Engineer Qualifications: Licensed in the same state as the project.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene, rubber or hermetically sealed compressed fiberglass.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

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4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.

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F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

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C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:
1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

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D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 16074

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SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Identification for raceways.
2. Identification for conductors.
3. Warning labels and signs.
4. Instruction signs.
5. Equipment identification labels.
6. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

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PART 2 - PRODUCTS

2.1 POWER RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:
1. Black letters on an orange field.
2. Legend: Indicate voltage.
3. letters on 20-inch (500-mm) centers.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

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B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:
1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. Paint: Comply with requirements in Division 9 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

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C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Accessible Raceways and Metal-Clad Cables More Than 600 V: Paint entire raceway system red and identify with "DANGER-HIGH VOLTAGE" in white letters at least 2 inches (50 mm) high. Repeat legend at 10-foot (3-m) maximum intervals.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:

1. Fire Alarm System: Red.

C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.

E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source and circuit number.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.

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2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

I. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled:

a. Panelboards, electrical cabinets, and enclosures.
b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards.
d. Transformers.
e. Emergency system boxes and enclosures.
f. Disconnect switches.
g. Enclosed circuit breakers.
h. Contactors.
i. Remote-controlled switches, dimmer modules, and control devices.
j. Voice and data cable terminal equipment.
k. Master clock and program equipment.
l. Intercommunication and call system master and staff stations.
m. Television/audio components, racks, and controls.
n. Fire-alarm control panel and annunciators.
o. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
p. Monitoring and control equipment.
q. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

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3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:

   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.

3. Colors for 480/277-V Circuits:

   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION 16075

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SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:
   1. Division 16 Section "Voice and Data Communication Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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

   1. Alcan Products Corporation; Alcan Cable Division.
   2. American Insulated Wire Corp.; a Leviton Company.
   3. General Cable Corporation.
   4. Senator Wire & Cable Company.
   5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN-2 and XHHW-2.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC and Type SO with ground wire.

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2.2 CONNECTORS AND SPLICES

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

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Feeders: Type THHN-THWN, single conductors in raceway.

C. Branch Circuits Concealed in Ceilings, Walls, Partitions, and Below Raised Access Floors: Type THHN-THWN, single conductors in raceway. Metal-clad cable (type MC) cable may be used where concealed above accessible ceilings and below accessible raised floors ~~for distances less than 50'~~ and not as homeruns to panelboards. Do not use MC cable where it will be exposed or subject to physical damage.

D. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Multi-Wire Branch Circuits: Install no more than three circuits in a raceway, unless specifically shown otherwise.

1. For 120V multi-wire branch circuits, provide shared neutral conductor that is one size larger than the phase conductors.

F. Minimum Branch Circuit Conductor Size: Provide the following minimum sizes for distances listed on 20A branch circuits to prevent excessive voltage drop. The circuit length shall be measured along the length of the conductor form the circuit breaker in the panelboard to the last device on the circuit. If required, increase raceway size to comply with conductor fill requirements of NFPA 70.

1. Branch Circuit Voltage of 120V:
   a. Circuit lengths less than 70 feet: Provide minimum #12 AWG conductor size.

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b. Circuit lengths between 70 feet and 110 feet: Provide minimum #10 AWG conductor size.
c. Circuit lengths between 110 feet and 170 feet: Provide minimum #8 AWG conductor size.
d. Circuit lengths greater than 170 feet: Perform voltage drop calculations and provide conductor size to keep branch circuit voltage drop less than 3% with a 15 amp load.

2. Branch Circuit Voltage of 277V:
   a. Circuit lengths less than 150 feet: Provide minimum #12 AWG conductor size.
   b. Circuit lengths between 150 feet and 240 feet: Provide minimum #10 AWG conductor size.
   c. Circuit lengths between 240 feet and 380 feet: Provide minimum #8 AWG conductor size.
   d. Circuit lengths greater than 380 feet: Perform voltage drop calculations and provide conductor size to keep branch circuit voltage drop less than 3% with a 15 amp load.

G. Fire Alarm Circuits: Type THHN-THWN, single conductors in raceway; or red MC cable.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

J. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 16 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 16 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

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B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 16120

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SECTION 16130 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.

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2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel, set-screw or compression type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

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B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

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

1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible type, approved for [plenum] [riser] [general-use] installation.

2.4 METAL WIREWAYS

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

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 or 3R as required by location, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type; gasketed for damp or wet locations.

E. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

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

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

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2.6 BOXES, ENCLOSURES, AND CABINETS

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

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1; minimum 4” x 4” square, unless otherwise indicated.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.

E. Nonmetallic Floor Boxes: Nonadjustable, round.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

I. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: Rigid steel conduit.

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3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased for main electrical and telephone service.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
6. Application of Handholes and Boxes for Underground Wiring:

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
   a. Stub-ups through floor.

3. Concealed in Ceilings and Interior Walls and Partitions: EMT, **or MC cable per section 160519.**
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: Rigid steel conduit.
6. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
7. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 16 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

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G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change to rigid steel conduit before rising above the floor.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
   a. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   b. Attics: 135 deg F (75 deg C) temperature change.

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2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

Q. Set metal floor boxes level and flush with finished floor surface.

R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 16130

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SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Isolated-ground receptacles.
3. Snap switches and wall-box dimmers.
4. Solid-state fan speed controls.
5. Wall-switch and exterior occupancy sensors.
6. Communications outlets.
7. Pendant cord-connector devices.
8. Cord and plug sets.
9. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

B. Related Sections include the following:
1. Division 16 Section "Voice and Data Communication Cabling" for workstation outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

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

B. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

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B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; CR 5253IG.
b. Leviton; 5362-IG.
c. Pass & Seymour; IG6300.

2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

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2.3 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; GF20.
b. Pass & Seymour; 2084.

2.4 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; L520R.
b. Hubbell; HBL2310.
c. Leviton; 2310.
d. Pass & Seymour; L520-R.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; IG2310.
b. Leviton; 2310-IG.

2. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.5 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

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1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221PL for 120 V and 277 V.
b. Hubbell; HPL1221PL for 120 V and 277 V.
c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
d. Pass & Seymour; PS20AC1-PLR for 120 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221L.
b. Hubbell; HBL1221L.
c. Leviton; 1221-2L.
d. Pass & Seymour; PS20AC1-L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 1995.
b. Hubbell; HBL1557.
c. Leviton; 1257.
d. Pass & Seymour; 1251.

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2.8 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. 2000 W minimum rating; illuminated when "OFF."

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.9 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.10 FLOOR SERVICE FITTINGS:

REFER TO WIRING DEVICE SCHEDULE AT THE END OF THIS SECTION

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum or solid brass with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Coordinate with voice/data cabling installer.

2.11 MULTIOUTLET ASSEMBLIES

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

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

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B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Wire: No. 12 AWG.

2.12 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.

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2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections ~~and prepare test reports~~.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
3. Report on any repairs.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or

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similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

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WIRING DEVICE SCHEDULE

Standard Wiring Device Schedule Note to Bidders: Comply with Section 16140 of the specifications. The catalog numbers listed below have been carefully prepared with the assistance of the manufacturer's representatives with the objective of assisting the bidders in determining the quality and ratings of the wiring device specified; however, the catalog numbers may not be complete or accurate. In addition, the color of the wiring device is not intended to be determined by the catalog numbers listed below, but shall be selected by the Architect as indicated in the specification. Each manufacturer prior to bidding shall compare catalog numbers shown with the description and shall notify the Architect/Engineer of any discrepancies.		
NEMA	DESCRIPTION	CATALOG NUMBERS
NEMA 5-20R	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498.	Bryant 5352 Hubbell CR5352 Leviton 5352 P&S 5352
NEMA 5-20R GFCI	20A, 125V 2 pole 3 wire duplex feed thru GFCI receptacles with indicator light. Nylon or Lexan decorator faces. Back and side wired. Internal components shall comply with FS W-C-596 where applicable. Comply with UL 498 and UL 493.	Bryant GFR53FT Hubbell GF5352 Leviton 6898 P&S 2091 S
NEMA 5-20R Isolated Ground	20A, 125V 2 pole 3 wire isolated ground duplex grounding receptacles. Nylon or Lexan faces. Back and side wired. Comply with FS W-C-596 and UL 498.	Bryant 5362IG Hubbell CR5352IG Leviton 5362 - IG P&S IG6300
NEMA 5-20R Waterproof (Weatherproof in use)	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498. Fully gasketed weatherproof while in use enclosure.	Hubbell CR5352/5051-0
NEMA 5-20R Weatherproof	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498. Cast aluminum and UL listed for wet locations.	Hubbell HBL5206WO
20A Single Pole	20A single pole 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1221 Leviton 1221 P & S 521 Bryant 4901
20A Three-way	20A three-way 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1223 Leviton 1223 P & S 523 Bryant 4903
20A Four-way	20A four-way 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1224 Leviton 1224 P & S 524 Bryant 4904
20A Double Pole	20A double pole 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 2 HP 240V. Double pole.	Hubbell CS1222 Leviton 1222 P & S 522 Bryant 4902
FB2	Flush dual service floor box suitable for the wiring method used. Floor box shall allow for activation in a single box. All connections shall be made below the finished surface of the floor inside the box. When the	Hubbell 3SFBSS/3SFBC Walker RFB4

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	box is in use, only the cords leaving the unit will be visible. Housing material shall be stamped steel. Provide wiring devices as indicated on the drawings. Provide barrier that separates power and signal compartments. Provide appropriate carpet and tile flanges.	
FB4	Flush four service floor box suitable for the wiring method used, 2.75” deep max. for concrete pour. Floor box shall allow for activation in a single box. All connections shall be made below the finished surface of the floor inside the box. When the box is in use, only the cords leaving the unit will be visible. Housing material shall be stamped steel. Provide (2) duplex power outlets and voice/data outlets as indicated. Provide barrier that separates power and signal compartments. Provide appropriate carpet and tile flanges. Finish of floor cover shall be as selected by the architect.	Hubbell HBL CFB401
FBA	Flush four service floor box suitable for the wiring method used, 2.75” deep max. for raised access floors. Floor box shall allow for activation in a single box. All connections shall be made below the finished surface of the floor inside the box. When the box is in use, only the cords leaving the unit will be visible. Housing material shall be stamped steel. Provide (2) duplex power outlets and voice/data outlets as indicated. Provide barrier that separates power and signal compartments. Provide appropriate carpet and tile flanges. Finish of floor cover shall be as selected by the architect.	Hubbell HBL AFB401
FB8	Special Systems floor box. 10” x 12” x 4” or 6” D steel box with 11 gauge flush steel cover suitable for concrete pour. Provide lift-off full access door and hinged trap-door for cables to exit. Provide leveling feet for in concrete installation. Provide two duplex power outlets, along with voice/data and AV outlets as indicated. Provide floor cover in finish as selected by the Architect.	FSR FL-500P
FB8A	Special Systems floor box. 10” x 12” x 6” D steel box with 11 gauge flush steel cover suitable for raised access floors. Provide lift-off full access door and hinged trap-door for cables to exit. Provide leveling feet for in concrete installation. Provide two duplex power outlets, along with voice/data and AV outlets as indicated. Provide floor cover in finish as selected by the Architect.	FSR FL-540P
PT1	Fire rated poke-thru: duplex receptacle with spring loaded lift cover flaps and 2 cable openings for 6PR cables. Thru floor fitting shall fit in 3” diameter hole and shall be rated for floor penetrated. Provide carpet flange.	Hubbell PT7FSDX Walker RC700-A
PT2	Fire rated poke-thru: 8-wire furniture connection and 2 cable openings for 6PR cables. Thru floor fitting shall fit in 3” diameter hole and shall be rated for floor penetrated. Provide carpet flange.	Hubbell PT73FFSDX Walker RC700-6A

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END OF SECTION 16140

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SECTION 16145 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following lighting control devices:
   1. Indoor photoelectric switches.
   2. Indoor occupancy sensors.
   3. Lighting contactors.
   4. Emergency shunt relays.

B. Related Sections include the following:
   1. Division 16 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

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

B. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 INDOOR PHOTOELECTRIC SWITCHES

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

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1. Lithonia Lighting; Acuity Lighting Group, Inc.
2. Paragon Electric Co.; Invensys Climate Controls.
3. Watt Stopper (The).

B. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Analog. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20-A lighting load at 120- and 277-V ac and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
3. Light-Level Monitoring Range: 10 to 1000 fc (108 to 10 800 lx), with an adjustment for turn-on and turn-off levels within that range.
4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

C. Skylight Photoelectric Sensors: Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight, facing up at skylight; with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Analog. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20-A lighting load at 120- and 277-V ac and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
3. Light-Level Monitoring Range: 10 to 1000 fc (108 to 10 800 lx), with an adjustment for turn-on and turn-off levels within that range.
4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.2 INDOOR OCCUPANCY SENSORS

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

1. Hubbell Lighting.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Watt Stopper (UVU Preferred).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

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a. Sensor: Suitable for mounting in any position on a standard outlet box.
b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.

C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.3 LIGHTING CONTACTORS

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

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Eaton Electrical Inc.; Cutler-Hammer Products.
4. GE Industrial Systems; Total Lighting Control.
5. Square D; Schneider Electric.

B. Description: Electrically operated and mechanically held, combination type with HOA switch, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.4 EMERGENCY SHUNT RELAY

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

1. Lighting Control and Design, Inc.

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2. Bodine

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 16 Section "Identification for Electrical Systems."

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1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: Sensors shall be adjusted after installation per the direction and approval of UVU.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 16 Section "Network Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 16145

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SECTION 16410 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Molded-case switches.
5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current rating.
4. UL listing for series rating of installed devices.
5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches and circuit breakers, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems" Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.

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 and the unit will be fully operational after the seismic event."

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2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

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2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I^2t response.

4. GFCI Circuit Breakers: Single- and two-pole configurations with [5] [30]-mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:

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1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
6. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

E. Molded-Case Switch Accessories:

1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.
4. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

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

3.2 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 16 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

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3.3 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. For wall-mounted switches and circuit breakers not at walls, provide freestanding racks complying with Division 16 Section "Hangers and Supports for Electrical Systems."

C. Anchor floor-mounting switches to concrete base.

D. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.
4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

B. Perform the following field tests and inspections:

1. Test mounting and anchorage devices according to requirements in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Report on any repairs.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

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3.7 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 16410

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SECTION 16442 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

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C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

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2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
   b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect/Owner no fewer than two weeks in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Architect/Owner's written permission.
3. Comply with NFPA 70E.

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

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a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Kitchen Areas: NEMA 250, Type 4X,.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
5. Finishes:

a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Same finish as panels and trim.

6. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:

1. Material: Tin-plated aluminum or hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Lugs: Mechanical type.
3. Extra-Capacity Neutral Lugs (where indicated): Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

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B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I^2t response.

4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
   d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
   f. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
   g. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

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h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 16 Section "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting: Install floor-mounted panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

E. Mount wall-mounted panelboards with top of trim 78 inches (1950 mm) above finished floor unless otherwise indicated.

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F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

K. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 16 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 16 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 16 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

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3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

END OF SECTION 16442

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SECTION 16461 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

   1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      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 and the unit will be fully operational after the seismic event."

   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control test reports.

E. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

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B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. General Electric Company.
3. Siemens Energy & Automation, Inc.
4. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum or copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

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B. Provide transformers that are constructed to withstand seismic forces specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

F. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.
3. Energy-Star Labeled.

K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

L. Wall Brackets: Manufacturer's standard brackets.

M. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 16 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 16 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

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

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

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3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 16461

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SECTION 16491 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches, controllers and motor-control centers.
2. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Time-current curves, coordination charts and tables, and related data.
4. Fuse size for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

a. Let-through current curves for fuses with current-limiting characteristics.
b. Time-current curves, coordination charts and tables, and related data.
c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA FU 1.

D. Comply with NFPA 70.

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1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Cooper Bussman, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

3.2 FUSE APPLICATIONS

A. Motor Branch Circuits: Class RK5, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

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3.4 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 16491

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SECTION 16511 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections:
1. Division 16 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
2. Division 16 Section " Modular Dimming Controls" for architectural dimming systems.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast.
4. Energy-efficiency data.
5. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 23 Section "Diffusers, Registers, and Grilles."
6. Life, output, and energy-efficiency data for lamps.

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7. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.

C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

D. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 3 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Ballasts: 1 for every 300 of each type and rating installed. Furnish at least one of each type.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. In Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

I. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

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2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; programmed-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 20 percent.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: 40 kHz or higher.
5. Lamp Current Crest Factor: 1.7 or less.
6. BF: between 0.71 and 0.78.
7. Power Factor: 0.95 or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.

C. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

D. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.

E. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.

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2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
11. Ballast Case Temperature: 75 deg C, maximum.

B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.5 BALLASTS FOR HID LAMPS

A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
4. Open-circuit operation that will not reduce average life.
5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 15 percent.
4. Transient Voltage Protection: IEEE C62.41, Category A or better.
5. Lamp Current Crest Factor: 1.5 or less.
6. Power Factor: .90 or higher.
7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
8. Protection: Class P thermal cutout.

C. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output.

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2.6 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

   a. Battery: Sealed, maintenance-free, nickel-cadmium type.
   b. Charger: Fully automatic, solid-state type with sealed transfer relay.
   c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.7 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

B. Color Temperature: As indicated on lighting fixture schedule, consistent color temperature throughout project.

C. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 3100 initial lumens (minimum), CRI 85 (minimum), and average rated life 20,000 hours, unless otherwise indicated.

D. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 85 (minimum), and average rated life of 20,000 hours, unless otherwise indicated.

E. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI 85 (minimum), and average rated life of 20,000 hours, unless otherwise indicated.

F. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), and average rated life of 20,000 hours, unless otherwise indicated.

G. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).

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2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
3. 16 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.8 HID LAMPS

A. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 75, and color temperature as indicated.

B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 75, and color temperature as indicated.

C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature as indicated.

2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 16 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

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4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust aimable lighting fixtures to provide required light intensities.

F. Connect wiring according to Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

~~B.~~ Report on any repairs.

END OF SECTION 16511

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SECTION 16572 - MODULAR DIMMING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Manual modular dimming controls.
   2. Integrated, multipreset modular dimming controls.

1.3 DEFINITIONS

A. Fade Rate: The time it takes each zone to arrive at the next scene, dependent on the degree of change in lighting level.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

C. Scene: The lighting effect created by adjusting several zones of lighting to the desired intensity.

D. SCR: Silicon-controlled rectifier.

E. Zone: A fixture or group of fixtures controlled simultaneously as a single entity. Also known as a "channel."

1.4 SUBMITTALS

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

   1. For modular dimming controls; include elevation, dimensions, features, characteristics, ratings, and labels.
   2. Device plates and plate color and material.
   3. Ballasts and lamp combinations compatible with dimmers.
   4. Wiring Diagrams: Power, signal, and control wiring.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

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1.6 COORDINATION

A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions. Include coordination with the following:
   1. Division 16 Section "Lighting Control Devices."

PART 2 - PRODUCTS

2.1 GENERAL DIMMING DEVICE REQUIREMENTS

A. Compatibility: Dimming control components shall be compatible with other elements of lighting fixtures, ballasts, transformers, and lighting controls.

B. Dimmers and Dimmer Modules: Comply with UL 508.

   1. Audible Noise and Radio-Frequency Interference Suppression: Solid-state dimmers shall operate smoothly over their operating ranges without audible lamp or dimmer noise or radio-frequency interference. Modules shall include integral or external filters to suppress audible noise and radio-frequency interference.
   2. Dimmer or Dimmer-Module Rating: Not less than 125 percent of connected load unless otherwise indicated.

C. Audio/Visual System Interface: Provide RS232 interface to allow dimming system to be controlled remotely through an audio/visual system. Coordinate with AV system installer.

2.2 MANUAL MODULAR MULTISCENE DIMMING CONTROLS

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

   1. Leviton Mfg. Company Inc.
   2. Lightolier Controls; a division of Lightolier; a Genlyte Group.
   3. Lutron Electronics, Inc.

B. Description: Factory-fabricated equipment providing manual modular dimming control consisting of a wall-box-mounted, master-scene controller and indicated number of wall-box zone stations. Controls and dimmers shall be integrated for mounting in one-, two-, or three-gang wall box under a single wall plate. Each zone station shall be adjustable to indicated number of scenes, which shall be recorded on the zone controller. Remote dimmers and power boosting devices are allowed to be controlled by these systems.

C. Operation: Automatically change variable dimmer settings of indicated number of zones simultaneously from one preset scene to another when a push button is operated.

D. Each manual modular multiscene dimming controller shall include a master control and remote controls.

E. Each zone shall be configurable to control the following:

   1. Fluorescent lamps with electronic ballasts.
   2. Incandescent lamps.

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3. Low-voltage incandescent lamps.

F. Memory: Retain preset scenes through power failures for at least seven days.

G. Device Plates: Style, material, and color shall comply with Division 16 Section "Wiring Devices."

H. Master-Scene Controller: Suitable for mounting in a single flush wall box.

1. Switches: Master off, group dim, group bright, and selectors for each scene.
2. LED indicator lights, one associated with each scene switch, and one for the master off switch.

I. Fluorescent Zone Dimmer: Suitable for operating lighting fixtures and ballasts specified in Division 16 Section "Interior Lighting," and arranged to dim number of scenes indicated for the master-scene controller. Scene selection is at the master-scene controller for setting light levels of each zone associated with scene.

1. Switch: Slider style for setting the light level for each scene.
2. LED indicator lights, one associated with each scene.
3. Electrical Rating: 2000 VA, 120 V.

J. Incandescent Zone Dimmer: Suitable for operating incandescent lamps at line-voltage or low-voltage lamps connected to a transformer and arranged to dim number of scenes indicated for the master-scene controller. Scene selection shall be at the master-scene controller for setting light levels of each zone associated with scene.

1. Switch: Slider style for setting the light level for each scene.
2. LED indicator lights, one associated with each scene.
3. Voltage Regulation: Dimmer shall maintain a constant light level, with no visible flicker, when the source voltage varies plus or minus 2 percent in RMS voltage.

2.3 INTEGRATED, MULTIPRESET MODULAR DIMMING CONTROLS

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

1. Crestron Lighting Controls.
2. Leviton Mfg. Company Inc.
3. Lightolier Controls; a division of Lightolier; a Genlyte Group.
4. Lithonia Lighting.
5. Lutron Electronics, Inc.

B. Indicate number of wall-box, remote-control stations.

C. Description: Factory-fabricated, microprocessor-based, solid-state controls providing manual dimming control consisting of a master station and multiple wall-box, remote-control stations.

D. Operation: Automatically changes variable dimmer settings of indicated number of zones simultaneously from one preset scene to another when a push button is operated.

E. Each zone shall be configurable to control the following:

1. Fluorescent lamps with electronic ballasts.

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2. Incandescent lamps.
3. Low-voltage incandescent lamps.

F. Memory: Retain preset scenes and fade settings through power failures by retaining physical settings of controls.

G. Master Station:

1. Contains control panel and multiple control and dimmer modules.
2. Controls and commands adjustment of each dimmer-zone setting for each scene change from one preset scene to another.

   a. Master zone raises and lowers lighting level.
   b. Adjustable fade rate for each scene from 1 to 60 seconds.

3. Rear-illuminated, scene-select buttons.
4. Lighting-level setting and fade-rate setting shall be graphically shown using LEDs or backlighted bar-graph indicator.
5. Mounting: Flush wall box with manufacturer's standard faceplate.

H. Remote-Control Stations:

1. Numbered push buttons to select scenes.
2. Off switch to turn master station off.
3. On switch turns all scenes of master station to full bright.
4. Control Wiring: NFPA 70, Class 2.
5. Mounting: Single flush wall box with manufacturer's standard faceplate.

I. Infrared Remote-Control Station: Same functions as for standard remote-control station, except that functions are input by a hand-held infrared transmitter.

J. Dimmers: Modular, plug-in type, with circuit breaker to protect the dimmer and branch circuit.

1. Dimming Circuit: Two SCR dimmers, in inverse parallel configuration.
2. Dimming Curve: Modified "square law" as specified in IESNA's "IESNA Lighting Handbook"; control voltage is 0- to 10-V dc.
3. Dimming Range: 0 to 100 percent, full output voltage not less than 98 percent of line voltage.
4. Voltage Regulation: Dimmer shall maintain a constant light level, with no visible flicker, when the source voltage varies plus or minus 2 percent in RMS voltage.
5. Dimming systems shall have filtering to reduce noise from lamp filaments. 350 ms minimum, 10-90% of the waveform, 80% load.

2.4 CONDUCTORS AND CABLES

A. Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

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PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with requirements in Division 16 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

A. Comply with requirements in Division 16 Section "Identification for Electrical Systems" for identifying components and power and control wiring.

B. Label each dimmer module with a unique designation.

C. Label each scene control button with approved scene description.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

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.

C. Tests and Inspections:

1. Continuity tests of circuits.
2. Operational Test: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.

a. Include testing of modular dimming control equipment under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

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D. Remove and replace malfunctioning modular dimming control components and retest as specified above.

E. Reports: Record repairs and adjustments.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain modular dimming controls.

B. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 16 Section "Network Lighting Controls."

END OF SECTION 16572

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SECTION 16725 - NURSE CALL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes [**visual/tone**] [**audiovisual/voice**] nurse-call system.

1.3 SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment cabinets and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Cabling Diagrams: Single-line block diagrams showing cabling interconnection of all components for this specific equipment. Include cable type for each interconnection.
   3. Station Installation Details: For built-in equipment, dimensioned and to scale.

C. Qualification Data: For qualified Installer.

D. Field quality-control reports.

E. Operation and Maintenance Data: For nurse-call equipment to include in emergency, operation, and maintenance manuals.

F. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Compatibility: System shall be capable of integration with any brand of phone system (wired or wireless), staff locating system, CCTV, and fire-alarm system.

C. Electrical Components, Devices, and Accessories: Listed and labeled according to UL 1069 as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace batteries that fail in materials or workmanship within specified warranty period. Special warranty for batteries applies to materials only, on a prorated basis for specified period.
   1. Warranty Period: Include the following warranty periods, from date of Substantial Completion:
      a. Nickel-Cadmium Batteries, Lithium Batteries, and Wet-Cell Batteries:
         1) Full Warranty: [**Five**] <**Insert number**> years.

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2) Pro Rata: [**15**] <**Insert number**> years.

1.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for [**two**] <**Insert number**> years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within [**two**] <**Insert number**> years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
1. Provide [**30**] <**Insert number**> days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: All colors for corridor dome lights and zone lights equal to [**20**] <**Insert number**> percent of amount installed.
2. Fuses: One for every 10 of each type and rating, but no fewer than <**Insert quantity**> of each.
3. Printed Circuit Boards: Each kind, equal to [**10**] <**Insert number**> percent of amount installed, but no fewer than one unit.
4. Master-Station Privacy Handset: [**One**] <**Insert number**>.
5. System program backup software.

PART 2 - PRODUCTS

2.1 NURSE-CALL SYSTEM GENERAL REQUIREMENTS

A. Station Zones: Able to program [**256**] <**Insert number**> station zones for each master station in the network with [**eight**] <**Insert number**> priority levels and addressable visual and audible annunciation of audible devices such as smoke detectors and door contacts.

B. System shall provide integrated and centralized "Code Blue" and "Staff Emergency" calls.

C. Expansion Capability: Equipment ratings, housing volume, spare keys, switches, relays, annunciator modules, terminals, and cable conductor quantities adequate to increase the number of stations in the future by [**25**] <**Insert number**> percent above those indicated without adding internal or external components or main trunk cable conductors.

D. Existing System Compatibility: Functionally and electrically compatible with existing system so components and wiring operate as an extension or upgrade of the existing system and existing or upgraded functional performance of the existing system applies to the entire final system. Colors, tones, types, and durations of signal manifestation shall be common among new and existing systems.

E. Resistance to Electrostatic Discharge: System, components, and cabling, and the selection, arrangement, and connection of materials and circuits, shall be protected against damage or diminished performance when subjected to electrostatic discharges of up to 25,000 V in an environment with a relative humidity of 20 percent or less.

F. Equipment: Microprocessor, electronic, modular.

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G. Master Nurse-Call Station: Programmed via a PC.

H. Wall-Mounted Component Connection Method: Components connect to system wiring in back boxes with factory-wired plug connectors.

I. Telephone Interface: Permit use of wired and wireless telephones to execute nurse-call master station functions.

J. Third-Party Pager Interface: Programmable to send tone, numeric, and alphanumeric message to pocket pagers or personal digital assistants and to use industry standard-protocol, RS-485 interface.

2.2 VISUAL/TONE NURSE-CALL SYSTEM

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
1. Aiphone Co., Ltd.
2. Alpha Communications.
3. Cornell Communications, Inc.
4. GE Security, Sound and Communications.
5. Intego Systems, Inc.
6. Intercall Systems, Inc.
7. Jeron Electronic Systems, Inc.
8. Rauland-Borg Corporation.
9. SimplexGrinnell LP.
10. TekTone Sound & Signal Mfg., Inc.
11. <**Insert manufacturer's name**>.

C. Operational Requirements:
1. Patient Station Call: Lights a steady call-placed lamp on the station, steady lamps in the zone light and corridor dome light associated with the patient's room, and steady lamps at the central annunciator and other system display devices and displays message on master and staff/duty stations. At the same time, it sounds a programmed tone at intervals, at the respective annunciator and master and staff/duty stations. Legends at the central annunciator and master station identify the calling station.
2. Pull-Cord-Call Station Call: Flashes a call-placed lamp on the station and distinctive-color lamps in the zone light and corridor dome light and at the central annunciator and staff/duty stations. At the same time, it sounds a programmed tone at intervals, at the central annunciator and master and staff/duty stations. A legend at the master station identifies the calling station, priority as programmed, and bed identification.
3. Emergency-Call Station Call: Produces the same responses as pull-cord-call station calls except rapidly flashing red emergency digital display and tone repetition rates are more frequent, tone frequency is higher, and lamps in the zone light and corridor dome light are a different color. Indicator lamps may be extinguished and the system reset only at the calling station. Displays message on pocket pagers, sounds programmed tone on phones, and displays message on display equipped phones.
4. System Reset: Operating reset button at the originating station cancels signals associated with the call. Illuminates a green digital display on the patient station and log presence on the master station.
5. Cord-Set Removal: Initiates a patient station call when the cord set is removed from the jack in the patient station faceplate. Displays location and "cord removed" message on

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master station, pocket pagers, and display equipped phones. Inserting a cord-set plug or a dummy plug into the jack and operating the station reset button resets the call.

6. Patient Control Unit: Controls entertainment volume and channel selection. Nurse button on the unit initiates a patient station call. Integral speaker reproduces entertainment sound.
7. Emergency Bath Station Call: Illuminates the digital display on the emergency bath station; rapidly flashes white dome lamp; displays location, priority, and bath on master station; and sounds programmed tone on master station display equipped phones and pocket pagers.
8. Staff/Duty Station Operation: Operation shall be identified to patient station except the message staff shall display on all devices when the staff call button is activated.
9. Privacy Key Activation: When privacy key is activated on patient station, the system shall disconnect the patient station microphone and slowly flash yellow privacy digital display on the patient station. Displays "privacy" on master station when selecting this room/bed.

D. Central Annunciator:
1. Lamp type.
2. Lamp Legends: Machine lettered and legible from a distance of at least 48 inches (1200 mm) when a call is present. Legend shall identify initiating station and priority of call.
3. Power-on Indicator: Digital, or push-to-test switch.
4. Audible Signal: Electronic tone.

E. Central Equipment Cabinet:
1. Lockable metal.
2. Houses power supplies, controls, terminal strips, and other components.
3. Power-on indicator lamp.
4. Battery Backup Unit: Sealed [**nickel-cadmium, wet-cell**] <**Insert type**> battery supplies power through an automatic switch when normal power fails, for a period of not less than [**six**] <**Insert number**> minutes at rated output. System shall lose no unanswered calls or calls in progress during the transfer operation.
   a. Automatic retransfer to normal power, after a [**15**] <**Insert number**>-minute time delay.
   b. Two-rate battery charger with an automatic trickle rate and a recharge rate.

F. Single-Patient Station: Call-placed lamp, reset push button, and polarized receptacle matching cord-set plug; mounted in a single faceplate.

G. Dual-Patient Station: Single call-placed lamp, single reset push button, and two polarized receptacles matching cord-set plug; mounted in a single faceplate.

H. Ambulatory-Patient Station: Call push-button switch, call-placed lamp, and reset push button; mounted in a single faceplate.

I. Staff/Duty Stations: A minimum of two call lamps, one for routine calls and one for emergency calls; and an audible tone signal device.

2.3 AUDIOVISUAL/VOICE NURSE-CALL SYSTEM

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

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1. Aiphone Co., Ltd.
2. Alpha Communications.
3. Cornell Communications, Inc.
4. GE Security, Sound and Communications.
5. Intego Systems, Inc.
6. Intercall Systems, Inc.
7. Jeron Electronic Systems, Inc.
8. Rauland-Borg Corporation.
9. SimplexGrinnell LP.
10. TekTone Sound & Signal Mfg., Inc.
11. <**Insert manufacturer's name**>.

C. Operational Requirements:
1. Station Selection from Master Station: Capable of selectively communicating with other stations or groups of stations on its system by touch screen, mouse click, or manual switch; and capable of programming up to [**256**] <**Insert number**> stations for each master station in the network.
2. Master Station Privacy: Capable of conversing with individual stations in complete privacy.
3. Called Station:
   a. Capable of hands-free and two-way conversation.
   b. Pressing "talk/listen" key shall cause the annunciation tone to cease.
   c. Pressing "cancel" key terminates normal calls and conversations.
   d. Terminating of high-priority level [**1**] [**2**] [**3**] [**or**] [**4**] shall not be allowed except at calling station location and shall send "remind" message if the call is not acknowledged at point of origin in programmed time frame.
4. Annunciation:
   a. At the master station, a programmable tone announces an incoming call; an annunciator light or digital display identifies the calling station and indicates the priority of the call.
   b. Call type indications include alarm assist, bath, bed, code, communication fault, cord out, door, emergency, and fire.
   c. Memory lamps or lighted displays identify stations selected for outgoing calls.
5. System Reset at Master Station: A normal, incoming call can be canceled, associated lights and audible tones extinguished, and the system reset when the station switch is returned to the normal position.
6. Patient Station Calls:
   a. Lights the call-placed lamp at patient station, zone, and corridor dome lights.
   b. Sounds a tone and lights the call lights at staff/duty stations and actuates annunciation at the master station.
   c. When the calling station is selected at the master station, the patient can converse with the master station without moving and without raising or directing the voice.
   d. During voice communications, entertainment audio at the calling station is automatically muted.
7. Pull-Cord-Call Station Calls and Emergency-Call Station Calls:
   a. Lights call-placed lamp and corridor dome light and flashes zone light.
   b. Master station tone pulses and annunciator light for that room flashes.
   c. When master station acknowledges the call by touch screen or switch, the tone stops but lights continue to flash until the call is canceled at the initiating point.
8. Code Blue and Staff/Duty Station Calls:
   a. Lights the call-placed lamp at the station and actuates annunciation at the master station.
   b. When the called station is selected at the master station, the caller and the master station operator can converse.
   c. Code Blue: Unique sound and light pattern indicating the highest priority emergency.

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d. Staff Station: Unique sound and light pattern indicating an emergency.
e. Duty Station: Sound and light pattern indicating a call to the nurse station.

9. Handset Operation: Lifting the handset on master station disconnects speaker/microphone and transfers conversation to the handset.
10. Station Privacy: No patient or staff/duty station can be remotely monitored without lighting a warning lamp at the monitored station.
11. Patient Station Cord-Set Removal:
    a. A patient station call is initiated as described above when a patient station cord-set plug is removed from the jack in the station faceplate.
    b. Tone stops but lights continue to flash until the call is canceled at the initiating point or the plug is reinserted or replaced with a dummy plug when the master station call button for the station is pressed.
12. Patient Control Unit:
    a. Controls entertainment volume and channel selection.
    b. Speaker is used for both nurse communication and entertainment sound.
    c. Entertainment sound is automatically muted when station is communicating with master station.
    d. Nurse button on the unit initiates a patient station call.
13. Selective Paging: Master station is capable of initiating a message to selected groups of stations or speakers simultaneously by using station group switches.
14. Staff Reminder:
    a. Master station can initiate a staff reminder that a patient requires direct staff response by operating a reminder control while in contact with the patient station.
    b. This reminder will light a distinctive-color lamp in the corridor dome light at the patient's room and in the appropriate zone lights.
    c. Reminder calls are canceled by operating a staff reminder cancel switch in the patient's room.
15. Call Priority Indication:
    a. Capable of [**eight**] <**Insert number**> call priority levels in addition to normal.
    b. Call priority switch near each patient station, or integral with the master station, shall control priority status of the call transmitted by individual stations.
    c. Switch selects one of the following status levels:
        1) Normal: No change to the normal call initiation and canceling sequence.
        2) Emergency: Call initiation produces signals and indications identical to those of emergency-call stations. Indicator lamps are extinguished and the system is reset only at the originating station.
        3) Priority: System response is the same for emergency status except voice communication between the master station and the calling station is locked in from the time of call initiation until the system is reset at the originating station.
16. Additional Call:
    a. Waiting display window on the master station similar to current call window displays incoming calls.
    b. Master station shall have a call-overflow indicator when incoming calls exceed <**Insert number**> calls.
    c. System shall store unlimited number of incoming calls.
    d. System shall be capable of automatically answering incoming calls in order of priority.
17. Calling Intercom Stations:
    a. Master station shall be capable of calling any intercom station using the handset or the hands-free speaker/microphone.
    b. Receipt of a call at the intercom station shall be preceded by an optional pre-announce tone.
    c. If there is a call in process, system shall place the active call on automatic hold while the new call is placed, then reestablish the previous call when the new call has ended.

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18. Privacy Override:
    a. Temporarily deactivates the "Privacy" mode of a called station by calling the station and instructing the called party to press the call-cord button.
    b. On completion of the conversation, the called station shall automatically return to the "Privacy" mode.
    c. When in "Privacy" mode, a called station shall be capable of hearing the master station; however, the master station shall not be capable of hearing the called station; a privacy message shall be indicated on the master station display.
19. Master-Station-to-Master-Station Calls:
    a. Master stations shall be capable of calling other master stations using the handset.
    b. Calls from master stations shall be answered using the handset only.
    c. Busy master stations shall be indicated by a master station intercom busy tone.
20. Voice Paging:
    a. Capable of voice paging to all stations using a single "All Call" key.[**The page shall be preceded by an optional pre-announce tone.**]
    b. Capable of voice paging to eight user-defined groups of stations by selecting the group and then the "All Call" key.[**The page shall be proceeded by a pre-announce tone.**]
    c. Capable of voice paging to all staff/duty stations and all patient stations where staff has registered presence using a single "Public Address (PA)/Staff" key.[**The page shall be proceeded by a pre-announce tone.**]
    d. Capable of voice paging through a third-party PA system.
    e. Capable of including or excluding any station from the voice paging function(s).
    f. Automatically places an active station call on hold during any page and reestablishes the connection at the end of the page.
    g. Automatically cancels a page if the talk mode is inactive for more than 15 seconds.
21. Station Monitor:
    a. An audio monitor feature shall allow a user to sequentially or simultaneously listen to one or all stations that are included in the user-created list.
    b. Master station display shall indicate which station is being monitored when in sequential mode.
    c. The dwell time each station is monitored shall be user programmable.
    d. The user shall be able to stop the monitoring sequence by activating a "pause" key.
    e. The user shall be able to manually sequence through stations using a "next" key.
22. Night Service:
    a. Functions shall be adaptable for nighttime staffing levels, patient traffic, and day/night operations.
    b. Staff Follow:
        1) Capable of locating roving staff; forwarding visual and audible annunciation of incoming calls to station(s) where personnel have registered presence.
        2) Master station shall display locations where staff have registered presence.
        3) Incorporates a programmable timer that automatically cancels a forgotten staff presence registration.
    c. Tones:
        1) Deactivates audio signals from a duty station and mini-master display telephones.
        2) Capable of changing the tone volume at the master and duty stations.
        3) Satellite function shall permit the user to deactivate audio signals from duty stations and other remote annunciator devices.
    d. Transfer:
        1) Permits one nurse station to take control of all or individually selected bed call cords from another nurse station. It shall be possible to view transfer status of a nurse station.
        2) Includes a minimum of three transfer modes to allow one nurse station to take control or share calls and operations from another nurse station.

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a) Parallel Transfer Mode: Permits both nurse stations to share all calls and operations.
b) Supervised Transfer Mode: Permits the transferred nurse station to share all calls and operations with the controlling nurse station; however, the controlling nurse station calls are not shared with the transferring station.
c) Capture Transfer Mode: Transfers all calls and operations from the transferred nurse station to the controlling nurse station.
d) Transferred station shall have no control over calls, and its display shall indicate calls have been transferred to another station.

3) Includes two "patient swing" modes to allow one nurse station to take control or share calls from one or many calls from another nurse station.
a) Supervised Transfer Mode: Permits the transferred calls to be shared with the controlling nurse station.
b) Capture Transfer Mode: Transfers all calls from the call cord from the transferred nurse station to the controlling nurse station.
c) Transferred station has no control over those transferred calls.

23. Service Request:
a. Permits users to assign a service request to a substation, at programmable priority level.
b. Displays service request on the nurse station display and light the green flashing corridor lamp at the respective substation and automatically generate a service reminder request.
c. Cancels service requests only at the initiating point.
d. Recall calls shall sound and be displayed at the master station if the service request has not been cancelled at the initiating point within the programmed period of time.

24. Call Reminder Function:
a. Automatically generates a reminder call for a patient- or staff-initiated, high-priority [**2**] [**3**] [**or**] [**4**] request that has had the call tones silenced, allowing time to physically attend to the request and cancel the call at the initiating point.
b. Regenerated calls shall display the same tones and visual indications and priority as the original call and shall also display a "regenerated call" message.
c. Capable of manually adding low-priority calls to the reminder list.
d. "Call Reminder" function and reminder timer shall be programmable by call priority.

25. Hide Function: Prevents a selected station from displaying calls or generating tones on the nurse station.

26. Door Control Function: Capable of being programmed to enable the user to remotely activate electric door locks.

27. Test and Diagnostics Feature:
a. Able to automatically diagnose system faults and categorize them as warnings, communication errors, or fatal errors.
b. Warnings shall indicate possible system problems.
c. Communication errors shall indicate the inability of the master station to communicate with a substation or another nurse-call station.
d. Fatal errors shall indicate a major hardware or software failure.

28. User-Configured System Programming - Access Code Not Required:
a. Patient call-cord priority levels.
b. Monitor list.
c. "All Call" list.
d. Master station communication parameters (volume, filtering, talk/listen, sensitivity).
e. Master and duty station call annunciation tone volume.
f. Date/time.
g. Staff-follow operating mode.
h. Transfer type.
i. Pocket pager list assignment.

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j. Presence mode.

29. User-Configured System Programming - Access Code Required:
    a. Master station number.
    b. Room device type.
    c. Room number.
    d. Bed number.
    e. Bed alpha or numeric.
    f. Reminder duration.
    g. Staff presence registration cancel duration.
    h. Display language.
    i. Paging group assignment(s).
    j. Zone group assignments.
    k. Monitoring duration.
    l. Pocket pager number.
    m. Call tone assignment by priority.
    n. Pretone activation.
    o. Call tones minimum volume.
    p. Clock mode (12 h/24 h).

D. Master Station:
1. Speaker/microphone unit with operating controls.
2. Indicator lamps with legends or by digital display designate identification and priority of calling stations and called stations.
3. Pulse rate of incoming-call lights denotes priority of calls awaiting response.
4. Station Selection Controls: Touchpad select stations for two-way voice communications.
5. Signal Tones: Programmable to announce incoming calls.
6. Pulse rate and frequency of tone identify the highest priority call awaiting response at one time.
7. Volume Control: Regulates incoming-call volume.
8. Privacy Handset with Hook Switch: Of the type that does not require push-to-talk switch attached to each station unless otherwise indicated.
9. Staff Reminder Control: Initiates flashing of corresponding corridor dome lights for patients requiring service. Permits scanning equipment to indicate which patients are currently in reminder status.
10. Call Priority Selection: Controls associated with patient-station selection switches determine the priority displayed when a call is initiated at a patient station.

E. Central Equipment Cabinet:
1. Lockable metal.
2. Houses amplifiers, tone generators, power supplies, controls, terminal strips, and other components.
3. Amplifier: With fidelity and overall gain necessary to achieve the sound-transmission and reproduction characteristics specified, considering interoperability with the installed speakers/microphones and wiring.
    a. Power Output: Not less than 3 W at a total harmonic distortion not exceeding 5 percent.
    b. Hum and Noise: 60 dB below full output with normal input open.
    c. Volume Control: Concealed within the amplifier unit to control the volume of sound reproduced at all stations.
    d. Protection: Circuit to prevent damage to the amplifier in case of shorted or open circuit.
4. Selective Paging Amplifiers: Plug-in card mounted in central equipment cabinet, rated 15 W.
5. System Power Supply:
    a. 24-V dc for operation of the call system.

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b. Equipment Rating: Suitable for continuous operation between 32 and 120 deg F (0 and 49 deg C), from a primary line voltage between 105- to 125-V ac, 60 Hz.
c. Output: Regulated 24-V dc with protection against overloads. Line-to-load regulation shall not exceed 2-1/2 percent with ripple and noise remaining below the 10-mV, rms level.
d. Overload Protection: Electronic fold-back circuit set to limit the volt-ampere output to less than 100 VA during overloaded or shorted output. Restore power output automatically on removal of overload without resetting circuit breakers or replacing fuses.

6. Power-on indicator lamp.
7. Surge Protector Device: Comply with Division 16 Section "Transient Voltage Suppression" for auxiliary panel suppressors, with [**digital indicator lights for power and protection status**] <**Insert accessories**>.
8. Battery Backup Unit: Sealed [**nickel-cadmium, wet-cell**] <**Insert type**> battery supplies power through an automatic switch when normal power fails, for a period of not less than [**six**] <**Insert number**> minutes at rated output.
   a. Automatic retransfer to normal power, after a [**15**] <**Insert number**>-minute time delay.
   b. Two-rate battery charger with an automatic trickle rate and a recharge rate.

F. Speaker/Microphones:
1. Type: Permanent-magnet, dynamic or ceramic, protected against dust and humidity.
2. Sound Reproduction: Sound level of 90 dB plus or minus 3 dB at a distance of 48 inches (1220 mm) on the axis without overdriving or distorting any frequencies between 300 and 3000 Hz when installed in an enclosure or in the pillow speaker.
3. Power Handling Capacity: Not susceptible to damage from overdriving within the range of power available from the amplifier.
4. Impedance Matching: Coordinated and matched to the input and output circuits of the amplifier, both for single connection and for group monitoring, to provide the sound reproduction specified. Subsystems or components shall not be combined, which could cause unacceptable distortion such as feedback between pillow speakers and unmuted room speaker/microphone combinations. This protection shall extend throughout the entire range of operation (volume control) of all components.

G. Single-Patient Station: Speaker/microphone with 2-inch (50-mm) dynamic cone, a polarized receptacle to match the cord-set plug, monitor lamp, reset switch, and call-placed lamp; assembled under a single faceplate.

H. Dual-Patient Station:
1. Speaker/microphone with 2-inch (50-mm) dynamic cone, two polarized receptacles to match cord-set plugs, monitor lamp, and reset switch; assembled under a single faceplate.
2. Single call-placed lamp serves both beds.
3. Dual call-placed lamps, one for each bed.

I. Staff/Duty Stations: Audible call-tone signal device, speaker/microphone with 2-inch (50-mm) dynamic cone, monitor lamp, reset switch, routine-call lamp, emergency-call lamp, and call push button; assembled under a single faceplate.

J. Code Blue Station: Audible call-tone signal device, speaker/microphone with 2-inch (50-mm) dynamic cone, monitor lamp, reset switch, Code Blue emergency-call lamp, and call push button; assembled under a single faceplate.

K. Ambulatory-Patient Station: Speaker/microphone with 2-inch (50-mm) dynamic cone, monitor lamp, reset switch, call-placed lamp, and call push button; assembled under a single faceplate.

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L. Selective Paging Speakers: 8-inch (200-mm) cone type with 1-inch (25-mm) voice coil and minimum 5-oz. (140-g) ceramic magnet, multitap matching transformer, flush-mounted steel back-box, and white enamel-finished metal ceiling grille.

M. Call Priority Switch Station: Three-position, tamper-resistant priority selection switch. Positions designated by labeling "Normal," "Emergency," and "Priority."

N. Staff Reminder Cancel Switch Station: Momentary contact.

2.4 SYSTEM COMPONENTS

A. Emergency-Call Station: Locking-type push button, labeled "Push to Call Help"; reset trigger to release push button and cancel call; and call-placed lamp, mounted in a single faceplate.

B. Emergency-Bath Station:
1. Consists of a sliding, chemical-resistant, ABS red fascia marked with the word "URGENT" in bold letters.
2. Capable of being activated with nylon pull cord or by sliding the face of the unit downwards.
3. Activation of the station shall illuminate a reassurance digital display on the face of the unit in addition to notifying the master station.
4. Water resistant and able to withstand routine cleaning and chemical disinfectants.
5. Uses magnetic reed switch technology for reliability and corrosion resistance.
6. Mounts on a single-gang electrical box wire to the respective patient station or input controller.

C. Code Blue Station:
1. Consists of a sliding, chemical-resistant, ABS blue fascia marked with the word "CODE" in bold letters.
2. Capable of being activated with nylon pull cord or by sliding the face of the unit downwards.
3. Activation of the station shall illuminate a reassurance digital display on the face of the unit in addition to notifying the master station.
4. Water resistant and able to withstand routine cleaning and chemical disinfectants.
5. Uses magnetic reed switch technology for reliability and corrosion resistance.
6. Mounts on a single-gang electrical box wire to the respective patient station or input controller.

D. Staff, Emergency Station:
1. Consists of a sliding, chemical-resistant, ABS red fascia marked with the word "EMERGENCY" in bold letters.
2. Capable of being activated with nylon pull cord or by sliding the face of the unit downwards.
3. Activation of the station shall illuminate a reassurance digital display on the face of the unit in addition to notifying the master station.
4. Mounts on a single-gang electrical box wire to the input controller.

E. Pull-Cord-Call Station:
1. Pull-Down Switch: Lever-locking type, labeled "Pull Down to Call Help."
2. Reset trigger.
3. Call-placed lamp.
4. Water-resistant construction.

F. Patient Control Unit:
1. Equipped with plug and 96-inch- (2400-mm-) long white cord.

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2. Ethylene oxide, sterilizable.
3. Light-Control Switch: Arranged for independent on-off control of patient's up and down light.
4. Integral Speaker: 2 inches (50 mm), with 0.35-oz. (9.9-g) magnet, rated 0.2 W.
5. Controls: Speaker volume, TV control, and nurse call.
6. Housing: High-impact white plastic.
7. Attachment: Stainless-steel bed clamp with permanently attached polyester film strap.
8. Quantity: 12 units for every 10 patient beds.

G. Call-Button Cord Set:
1. Plug and 72-inch (1800-mm) white cord; cord set shall be resistant to medical gas environment equipped with momentary-action, call-button switch.
2. Ethylene oxide, sterilizable.
3. Washable cord.
4. Palladium switch contacts in high-impact white housing with cord-set strain relief.
5. Attachment: Stainless-steel bed clamp with permanently attached polyester film strap.
6. Quantity: Three cord sets for every 10 patient beds.

H. Geriatric Call-Button Cord Set:
1. Plug and 72-inch (1800-mm) white cord.
2. Resistant to medical gas environment equipped with momentary-action, light-pressure switch in soft outer jacket.
3. Ethylene oxide, sterilizable.
4. Washable cord.
5. Palladium switch contacts in high-impact white housing with cord-set strain relief.
6. Attachment: Stainless-steel bed clamp with permanently attached polyester film strap.
7. Quantity: Two cord sets for every 10 patient beds.

I. Squeeze-Bulb Switch Cord Set:
1. Plug and 72-inch (1800-mm) washable tube with white cord set.
2. Resistant to medical gas environment; washable; equipped with neoprene squeeze-bulb activator, and plug-mounted, momentary contact switch.
3. Ethylene oxide, sterilizable.
4. Attachment: Stainless-steel bed clamp with permanently attached polyester film strap.
5. Quantity: Two cord sets for every 10 patient beds.

J. Breath Call Cord:
1. Flexible PVC jacketed cable and a momentary contact air-pressure sensitive switch.
2. Cord: 108 inches (2700 mm) long.
3. Include an adjustable arm for clamping and suitable for use in oxygen atmospheres.
4. Include 12 replacement straws.

K. Pillow Speakers:
1. Eight-conductor, DIN, flexible PVC jacketed cable.
2. Contain nurse-call button, volume control, speaker, and channel control in molded flame-retardant ABS housing.
3. Cord: 96 inches (2400 mm) long with sheet clip.

L. Call-Button Plug:
1. Designed to plug into patient station cord-set receptacle.
2. Button switches call circuit.
3. Two plugs for every 10 patient beds.

M. Dummy Plugs:
1. Designed to plug into patient station cord-set receptacle when call-button plug or patient cord set is not used.

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2. Three plugs for every 10 patient beds.

N. Indicator Lamps: Digital type with rated life of 20 years unless otherwise indicated.

O. Station Faceplates:
1. Stainless steel, a minimum of 0.0375 inch (0.95 mm) thick.
2. Finish: Brushed.
3. Machine-engraved labeling identifies indicator lamps and controls.

P. Station Faceplates:
1. High-impact plastic.
2. Color: [**Beige**] <**Insert color**>.
3. Molded or machine-engraved labeling identifies indicator lamps and controls.

Q. Corridor Dome Lights and Zone Lights:
1. Three-lamp signal lights.
2. Lamps: Front replaceable without tools, low voltage with rated life of 7500 hours. Barriers are such that only one color is displayed at a time.
3. Lenses: Heat-resistant, shatterproof, translucent polymer that will not deform, discolor, or craze when exposed to hospital cleaning agents.
4. Filters: Two per unit, amber and red.

R. Cable:
1. Conductors: Jacketed single and multiple, twisted-pair copper cables.
2. Sizes and Types: As recommended by equipment manufacturer.
3. Cable for Use in Plenums: Listed and labeled for plenum installation.

S. Grounding Components: Comply with requirements in Division 16 Section "Grounding and Bonding."

2.5 SOFTWARE REQUIREMENTS

A. Telephone System Interface:
1. Permits use of wired and/or wireless telephones to execute nurse-call master station.
2. Two-way communication with patient and staff stations.
3. Two-way communication with the master nurse station.
4. "All Call," group call, and staff call paging.
5. Capable of being programmed to forward calls destined for a master nurse station to any connected telephone.
6. Telephones connected to the telephone interface shall have the same call tone ring patterns as those generated at the master nurse station.
7. Telephones having a display shall indicate the call type, priority code, and the calling station number of incoming calls.
8. Telephones shall be capable of initiating a service request for a particular patient station, logging calls on the master station's reminder list, and activating door lock mechanisms associated with a call station.
9. Capable of routine setup and configuration changes using the keypads on display telephone and/or the master station.

B. Display Telephones:
1. Digital telephones for use as mini-master nurse-call stations.
2. Digital display shall indicate the call type, priority code, and calling station number of incoming calls.
3. Ring patterns shall be identical to those generated at the master station.

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4. Capable of two-way communication with patient and staff stations and the master station, and other telephones interfaced with the system.
5. Capable of placing or answering outside calls when interfaced with the facility telephone system.
6. Capable of "All Call," group call, and staff call paging and of initiating service requests, logging calls to the reminder list, and activating optional door controls.

C. Third-Party Pocket Pager Interface:
1. Equipped with a standalone pocket pager interface.
2. Connects with the facility paging system and transmit alphanumeric messages to the pocket pagers as preprogrammed in the system.

D. Statistical Software:
1. Includes a data statistical software package that stores, sorts, and analyzes activities occurring on the nurse-call system network.
2. Windows based and operated on a PC that is connected to the nurse-call system network.
3. Stores events on the PC's hard disk. Accumulation of these stored events shall make up the database that is used to generate reports and statistics.
4. Events stored by the software shall include date, day of week, time, ward, priority, and room number.
5. Capable of assigning a patient name to bed number.
6. Stored events shall include, but not be limited to, calls placed, call priority, calls cancelled at the nurse station, calls cancelled at the point of origin, regenerated calls, calls answered, calls sent to pager interface, staff presence registration, staff presence cancellation, service request, service cancellation, and system and network error messages.

E. Data Analysis Software:
1. Capable of analyzing the stored information and generating computed analysis.
2. Analysis of the database can be conducted by specifying one, many, or all of the following parameters of the database: date, day of week, time, wards, priority, and room number.
3. Analysis shall include, but not be limited to, total number of calls placed, average call response time (from call placed to call cancellation), total number of presence registrations, average presence time in a room, total number of service requests, average response time (from audio answer to call cancellation), and average ring time (from call placed to audio answer).

F. Statistical Software Package:
1. Capable of displaying multiple calls/events on a PC monitor or on a RS-485 data-bus-driven digital display panel.
2. Calls from patient or staff stations and associated devices shall be displayed by priority. Display shall be customizable as follows:
   a. Choice of color by type of call.
   b. Choice of display size (character size).
   c. Choice of priority levels, type of events, points of origin.
   d. Identification of facility.
   e. Identification of ward.
   f. Identification of patient with specific patient information.

2.6 CONDUCTORS AND CABLES

A. Audio Cables:
1. Conductors: Jacketed, twisted-pair and twisted-multipair, untinned solid copper. Sizes as recommended by system manufacturer, but no smaller than No. 22 AWG.

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2. Insulation: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
3. Shielding: For speaker/microphone leads and elsewhere where recommended by manufacturer; No. 34 AWG, tinned, soft-copper strands formed into a braid or equivalent foil.
4. Minimum Shielding Coverage on Conductors: 60 percent.
5. Plenum Cable: Listed and labeled for plenum installation.

B. Data Cable and Hardware: [**Category 5e**] [**Category 6**] UTP and UTP hardware. Comply with requirements in Division 16 Section "Communications Horizontal Cabling."

C. Power Conductors and Cables: Copper, solid, No. 20 AWG. Comply with requirements in Division 16 Section "Conductors and Cables."

D. Grounding Conductors and Cables: Copper, stranded, No. 16 AWG. Comply with requirements in Division 16 Section "Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wiring Method:
1. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters[**and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used**].
   a. Install plenum cable in environmental air spaces, including plenum ceilings.
   b. Conceal raceway and cables except in unfinished spaces.
2. Cable Trays: Comply with requirements in Division 16 Section "Communications Horizontal Cabling."
3. Conduit and Boxes: Comply with requirements in Division 16 Section "Raceways and Boxes."[**Flexible metal conduit shall not be used.**]
   a. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

B. Install cables without damaging conductors, shield, or jacket.

C. Do not bend cables, while handling or installing, to radii smaller than as recommended by manufacturer.

D. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
1. Pull cables simultaneously if more than one is being installed in same raceway.
2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.

E. Install exposed raceways and cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours. Secure and support cables by straps, staples, or similar fittings designed and installed so as not to damage cables. Secure cable at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, or fittings.

F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

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G. Separation of Wires: Separate speaker/microphone, line-level, speaker-level, and power-wiring runs. Run in separate raceways or, if exposed or in same enclosure, provide 12-inch (300-mm) minimum separation between conductors to speaker/microphones and adjacent parallel power and telephone wiring. Provide separation as recommended by equipment manufacturer for other conductors.

H. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Install terminal cabinets where there are splices, taps, or terminations for eight or more conductors.

I. Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks if required.

J. Identification of Conductors and Cables: Comply with requirements in Division 16 Section "Communications Horizontal Cabling" for cable administration, cable schedule, and cable and wire identification.

K. Equipment Identification:
1. Comply with requirements in Division 16 Section "Electrical Identification" for equipment labels and signs and labeling installation requirements.
2. Label stations, controls, and indications using approved consistent nomenclature.

3.2 EXISTING SYSTEMS

A. Examine existing systems for proper operation, compatibility with new equipment, and deficiencies. If discrepancies or impairments to successful connection and operation of interconnected equipment are found, report them and do not proceed with installation until directed. Schedule existing systems' examination so there is reasonable time to resolve problems without delaying construction.

3.3 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other signal impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding except at connection to main building ground bus.

C. Grounding Provisions: Comply with requirements in Division 16 Section "Grounding and Bonding."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. 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.

C. Tests and Inspections:
1. Schedule tests a minimum of seven days in advance.
2. Report: Submit a written record of test results.

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3. Operational Test: Perform an operational system test and demonstrate proper operations, adjustment, and sensitivity of each station. Perform tests that include originating station-to-station and "All Call" messages and pages at each nurse-call station. Verify proper routing, volume levels, and freedom from noise and distortion. Test each available message path from each station on the system. Meet the following criteria:
   a. Speaker Output: 90 dB plus or minus 3 dB, 300 to 3000 Hz, reference level threshold of audibility 0 dB at 0.02 mPa of sound pressure.
   b. Gain from patient's bedside station to nurse station, with distortion less than 65 dB (plus or minus 3 dB, 300 to 3000 Hz).
   c. Signal-to-Noise Ratio: Hum and noise level at least 45 dB below full output.
4. Test Procedure:
   a. Frequency Response: Determine frequency response of two transmission paths by transmitting and recording audio tones.
   b. Signal-to-Noise Ratio: Measure the ratio of signal to noise of the complete system at normal gain settings using the following procedure: Disconnect a speaker/microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure the ratio of signal to noise and repeat the test for four speaker microphones.
   c. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 300, 400, 1000, and 3000 Hz into each nurse-call equipment amplifier, and measure the distortion in the amplifier output.

D. Retesting: Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense. Verify, by the system test, that the total system meets these Specifications and complies with applicable standards. Report results in writing.

E. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

F. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within [**12**] <**Insert number**> months of date of Substantial Completion, provide on-site assistance in adjusting sound levels and controls to suit actual occupied conditions. Provide up to [**three**] <**Insert number**> visits to Project during other-than-normal operating hours for this purpose.

3.6 DEMONSTRATION

A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel and caregiver staff to adjust, operate, and maintain nurse-call equipment.

END OF SECTION 16725

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SECTION 16726 - PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Preamplifiers.
2. Power amplifiers.
3. Transfer to standby amplifier.
4. Microphones.
5. Volume limiter/compressors.
6. Control console.
7. Equipment cabinet.
8. Equipment rack.
9. Telephone paging adapters.
10. Tone generator.
11. Monitor panel.
12. Loudspeakers.
13. Noise-operated gain controllers.
14. Microphone and headphone outlets.
15. Battery backup power unit.
16. Conductors and cables.
17. Raceways.

1.3 DEFINITIONS

A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.

B. VU: Volume unit.

C. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports and seismic restraints for control consoles, equipment cabinets and racks, and components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Supports and seismic restraints for control consoles, equipment cabinets and racks, and components shall withstand the effects of earthquake motions determined according to [SEI/ASCE 7] <Insert requirement>.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[and the unit will be fully operational after the seismic event]."

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1.5 SUBMITTALS

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

B. Shop Drawings: For supports and seismic restraints for control consoles, equipment cabinets and racks, and components. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Console layouts.
   3. Control panels.
   4. Rack arrangements.
   5. Calculations: For sizing backup battery.
   6. Wiring Diagrams: For power, signal, and control wiring.
      a. Identify terminals to facilitate installation, operation, and maintenance.
      b. Single-line diagram showing interconnection of components.
      c. Cabling diagram showing cable routing.

C. Delegated-Design Submittal: For supports and seismic restraints for control consoles, equipment cabinets and racks, and components indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of supports and seismic restraints for control consoles, equipment cabinets and racks, and components.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from installers of the items involved.

E. Qualification Data: For qualified [Installer] [and] [testing agency].

F. Seismic Qualification Certificates: For control consoles, equipment cabinets and racks, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Field quality-control reports.

H. Operation and Maintenance Data: For public address and mass notification systems to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
   1. Personnel certified by NICET as Audio Systems [Level II] [Level III] Technician.
   2. <Insert qualification>.

B. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated.

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1. Testing Agency's Field Supervisor: Currently certified by NICET at Level III to supervise on-site testing.

C. Source Limitations: Obtain public address and mass notification systems from single source from single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Microphone: [One] <Insert number>.
2. Desk Stand(s): [One] <Insert number>.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
1. Alpha Communications.
2. Altec Lansing Technologies, Inc.
3. Atlas Sound LP.
4. Bogen Communications, Inc.
5. Dukane Communication Systems; part of GE Infrastructure, Security.
6. Edwards Signaling & Security Systems; part of GE Infrastructure, Security.
7. Electro-Voice; Telex Communications, Inc.
8. Federal Signal Corporation; Electrical Products Division.
9. Peavey Electronics.
10. Rauland-Borg Corporation.
11. Whelen Engineering Company, Inc.
12. <Insert manufacturer's name>.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. System Functions:
1. Selectively connect any zone to any available signal channel.
2. Selectively control sound from microphone outlets and other inputs.
3. "All-call" feature shall connect the all-call sound signal simultaneously to all zones regardless of zone or channel switch settings.
4. Telephone paging adapter shall allow paging by dialing an extension from any local telephone instrument and speaking into the telephone.
5. Produce a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.

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6. Reproduce high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; output free of nonuniform coverage of amplified sound.

2.3 GENERAL EQUIPMENT AND MATERIAL REQUIREMENTS

A. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Equipment: Comply with UL 813. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

C. Equipment Mounting: Where rack, cabinet, or console mounting is indicated, equipment shall be designed to mount in a 19-inch (483-mm) housing complying with TIA/EIA-310-D.

D. Weather-Resistant Equipment: Listed and labeled by a qualified testing agency for duty outdoors or in damp locations.

2.4 PREAMPLIFIERS

A. Preamplifier: Separately mounted.

B. Preamplifier: Integral to power amplifier.

C. Output Power: Plus 4 dB above 1 mW at matched power-amplifier load.

D. Total Harmonic Distortion: Less than 1 percent.

E. Frequency Response: Within plus or minus 2 dB from 20 to 20,000 Hz.

F. Input Jacks: Minimum of two. One matched for low-impedance microphone; the other matchable to cassette deck, CD player, or radio tuner signals without external adapters.

G. Minimum Noise Level: Minus 55 dB below rated output.

H. Controls: On-off, input levels, and master gain.

2.5 POWER AMPLIFIERS

A. Mounting: [Console] [Rack].

B. Output Power: 70-V balanced line. [80 percent of the sum of wattage settings of connected] <Insert wattage> for each station and speaker connected in all-call mode of operation, plus an allowance for future stations.

C. Total Harmonic Distortion: Less than 3 percent at rated power output from 50 to 12,000 Hz.

D. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.

E. Frequency Response: Within plus or minus 2 dB from 50 to 12,000 Hz.

F. Output Regulation: Less than 2 dB from full to no load.

G. Controls: On-off, input levels, and low-cut filter.

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H. Input Sensitivity: Matched to preamplifier and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphone or handset transmitter.

2.6 TRANSFER TO STANDBY AMPLIFIER

A. Monitoring Circuit and Sensing Relay: Detect reduction in output of power amplifier of 40 percent or more and, in such event, transfer load and signal automatically to standby amplifier.

2.7 MICROPHONES

A. Paging Microphone:
1. Type: Dynamic, with [cardioid] [omni] polar characteristic.
2. Impedance: 150 ohms.
3. Frequency Response: Uniform, 50 to 14,000 Hz.
4. Output Level: Minus 58 dB, minimum.
5. Finish: Satin chrome.
6. Cable: C25J.
7. Mounting: Desk stand with integral-locking, press-to-talk switch.

B. <Insert microphone type>.

2.8 VOLUME LIMITER/COMPRESSOR

A. Minimum Performance Requirements:
1. Frequency Response: 45 to 15,000 Hz, plus or minus 1 dB minimum.
2. Signal Reduction Ratio: At least a 10:1 and 5:1 selectable capability.
3. Distortion: 1 percent, maximum.
4. Rated Output: Minimum of plus 14 dB.
5. Inputs: Minimum of two inputs with variable front-panel gain controls and VU or decibel meter for input adjustment.
6. Rack mounting.

2.9 CONTROL CONSOLE

A. Cabinet: Modular, [desktop] [desk style]; complying with TIA/EIA-310-D.

B. Housing: Steel, 0.0478 inch (1.2 mm) minimum, with removable front and rear panels. Side panels are removable for interconnecting side-by-side mounting.

C. Panel for Equipment and Controls: Rack mounted.

D. Controls:
1. Switching devices to select signal sources for distribution channels.
2. Program selector switch to select source for each program channel.
3. Switching devices to select zones for paging.
4. All-call selector switch.

E. Indicators: A visual annunciation for each distribution channel to indicate source being used.

F. Self-Contained Power and Control Unit: A single assembly of basic control, electronics, and power supply necessary to accomplish specified functions.

G. Spare Positions: 20 percent spare zone control and annunciation positions on console.

H. Microphone jack.

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2.10 EQUIPMENT CABINET

A. Comply with TIA/EIA-310-D.

B. House amplifiers and auxiliary equipment at each location.

C. Cabinet Housing:
1. Constructed of 0.0478-inch (1.2-mm) steel, minimum, with front- and rear-locking doors and standard TIA/EIA-310-D-compliant, 19-inch (483-mm) racks.
2. Arranged for floor or wall mounting as indicated.
3. Sized to house all equipment indicated, plus spare capacity.
4. Include [20] <Insert number> percent minimum spare capacity for future equipment in addition to space required for future cassette deck and CD player.

D. Power Provisions: A single switch in cabinet shall disconnect cabinet power distribution system and electrical outlets, which shall be uniformly spaced to accommodate ac-power cords for each item of equipment.

E. Ventilation: A low-noise fan for forced-air cabinet ventilation. Fan shall be equipped with a filtered input vent and shall be connected to operate from 105- to 130-V ac, 60 Hz; separately fused and switched; arranged to be powered when main cabinet power switch is on.

2.11 EQUIPMENT RACK

A. Racks: 19 inches (483 mm) standard, complying with TIA/EIA-310-D.

B. Power-Supply Connections: Compatible plugs and receptacles.

C. Enclosure Panels: Ventilated rear and sides and solid top. Use louvers in panels to ensure adequate ventilation.

D. Finish: Uniform, baked-enamel factory finish over rust-inhibiting primer.

E. Power-Control Panel: On front of equipment housing, with master power on-off switch and pilot light; and with socket for 5-A cartridge fuse for rack equipment power.

F. Service Light: At top rear of rack with an adjacent control switch.

G. Vertical Plug Strip: Grounded receptacles, 12 inches (300 mm) o.c.; the full height of rack.

H. Maintenance Receptacles: Duplex convenience outlets supplied independent of vertical plug strip and located in front and bottom rear of rack.

I. Spare Capacity: [20] <Insert number> percent in rack for future equipment.

2.12 TELEPHONE PAGING ADAPTER

A. Adapters shall accept voice signals from telephone extension dialing access and automatically provide amplifier input and program override for preselected zones.
1. Minimum Frequency Response: Flat, 200 to 2500 Hz.
2. Impedance Matching: Adapter matches telephone line to public address equipment input.
3. Rack mounting.

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2.13 TONE GENERATOR

A. Generator shall provide clock and program interface with public address and mass notification system.

B. Signals: Minimum of seven distinct, audible signal types including wail, warble, high/low, alarm, repeating and single-stroke chimes, and tone.

C. Pitch Control: Chimes and tone.

D. Volume Control: All outputs.

E. Activation-Switch Network: Establishes priority and hierarchy of output signals produced by different activation setups.

F. Mounting: Rack.

2.14 MONITOR PANEL

A. Monitor power amplifiers.

B. Components: VU or dB meter, speaker with volume control, and multiple-position rotary selector switch.

C. Selector Switch and Volume Control: Selective monitoring of output of each separate power amplifier via VU or dB meter and speaker.

D. Mounting: Rack.

2.15 LOUDSPEAKERS

A. Cone-Type Loudspeakers:
1. Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.
2. Frequency Response: Within plus or minus 3 dB from 50 to 15,000 Hz.
3. Size: 8 inches (200 mm) with 1-inch (25-mm) voice coil and minimum 5-oz. (140-g) ceramic magnet.
4. Minimum Dispersion Angle: 100 degrees.
5. Rated Output Level: 10 W.
6. Matching Transformer: Full-power rated with four taps. Maximum insertion loss of 0.5 dB.
7. Surface-Mounting Units: Ceiling, wall, or pendant mounting, as indicated, in steel back boxes, acoustically dampened. Front face of at least 0.0478-inch (1.2-mm) steel and whole assembly rust proofed and shop primed for field painting.
8. Flush-Ceiling-Mounting Units: In steel back boxes, acoustically dampened. Metal ceiling grille with [white] <Insert color> baked enamel.

B. Horn-Type Loudspeakers:
1. Type: Single-horn units, double-reentrant design, with minimum full-range power rating of 15 W.
2. Matching Transformer: Full-power rated with four standard taps. Maximum insertion loss of 0.5 dB.
3. Frequency Response: Within plus or minus 3 dB from 250 to 12,000 Hz.
4. Dispersion Angle: 130 by 110 degrees.
5. Mounting: Integral bracket.

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6. Units in Hazardous (Classified) Locations: Listed and labeled for environment in which they are located.

2.16 NOISE-OPERATED GAIN CONTROLLER

A. Gain controller shall be designed to continuously sense space noise level and automatically adjust signal level to local speakers.

B. Frequency Response: 20 to 20,000 Hz, plus or minus 1 dB.

C. Level Adjustment Range: 20 dB minimum.

D. Maximum Distortion: 1 percent.

E. Control: Permits adjustment of sensing level of device.

2.17 OUTLETS

A. Volume Attenuator Station: Wall-plate-mounted autotransformer type with paging priority feature.
1. Wattage Rating: 10 W unless otherwise indicated.
2. Attenuation per Step: 3 dB, with positive off position.
3. Insertion Loss: 0.4 dB maximum.
4. Attenuation Bypass Relay: Single pole, double throw. Connected to operate and bypass attenuation when all-call, paging, program signal, or prerecorded message features are used. Relay returns to normal position at end of priority transmission.
5. Label: "PA Volume."

B. Microphone Outlet: Three-pole, polarized, locking-type, microphone receptacles in single-gang boxes. Equip wall outlets with brushed stainless-steel device plates. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed outlet covers.

C. Headphone Outlet (for the Hearing Impaired): Microphone receptacles in single-gang boxes. Equip wall outlets with brushed stainless-steel device plates. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed-outlet covers.

2.18 BATTERY BACKUP POWER UNIT

A. Unit shall be rack mounted, consisting of time-delay relay, sealed lead-calcium battery, battery charger, on-off switch, "normal" and "emergency" indicating lights, and adequate capacity to supply maximum equipment power requirements for one hour of continuous full operation.

B. Unit shall supply public address equipment with 12- to 15-V dc power automatically during an outage of normal 120-V ac power.

C. Battery shall be on float charge when not supplying system and to transfer automatically to supply system after three to five seconds of continuous outage of normal power, as sensed by time-delay relay.

D. Unit shall automatically retransfer system to normal supply when normal power has been reestablished for three to five seconds continuously.

2.19 CONDUCTORS AND CABLES

A. Jacketed, twisted pair and twisted multipair, untinned solid copper.

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1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
2. Microphone Cables: Neoprene jacketed, not less than 2/64 inch (0.8 mm) thick, over shield with filled interstices. Shield No. 34 AWG, tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on conductors is not less than 60 percent.
3. Plenum Cable: Listed and labeled for plenum installation.

2.20 RACEWAYS

A. Conduit and Boxes: Comply with Division 16 Section "Raceways and Boxes."[Flexible metal conduit shall not be used.]
   1. Outlet boxes shall be not less than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters[, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used]. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Division 16 Section "Raceways and Boxes."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF RACEWAYS

A. Comply with requirements in Division 16 Section "Raceways and Boxes" for installation of conduits and wireways.

B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Cable Installation Requirements:
   1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
   2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
   3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

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5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

C. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend speaker cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceiling by cable supports not more than [60 inches (1524 mm)] <Insert dimension> apart.
3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

3.4 INSTALLATION

A. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

B. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.

C. Equipment Cabinets and Racks:
1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.
2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
3. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.

D. Volume Limiter/Compressor: Equip each zone with a volume limiter/compressor. Install in central equipment cabinet. Arrange to provide a constant input to power amplifiers.

E. Wall-Mounted Outlets: Flush mounted.

F. Floor-Mounted Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas.

G. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.

H. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.

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I. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.

J. Connect wiring according to Division 16 Section "Conductors and Cables."

3.5 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes as specified in Division 16 Section "Grounding and Bonding."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:
1. Schedule tests with at least seven days' advance notice of test performance.
2. After installing public address and mass notification systems and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
   a. Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.
   b. Repeat test for each separately controlled zone of loudspeakers.
   c. Minimum acceptance ratio is 50 dB.
5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.

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7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.
8. Signal Ground Test: Measure and report ground resistance at pubic address equipment signal ground. Comply with testing requirements specified in Division 16 Section "Grounding and Bonding."

E. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

F. Public address and mass notification systems will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.
1. Include a record of final speaker-line matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.

3.7 STARTUP SERVICE

A. [Engage a factory-authorized service representative to perform] [Perform] startup service.
1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
2. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.

B. Occupancy Adjustments: When requested within [12] <Insert number> months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [two] <Insert number> visits to Project during other-than-normal occupancy hours for this purpose.

3.9 DEMONSTRATION

A. [Engage a factory-authorized service representative to train] [Train] Owner's maintenance personnel to adjust, operate, and maintain the public address and mass notification systems and equipment.

END OF SECTION 16726

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SECTION 16727 - SOUND-MASKING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Electronic noise generators.
2. Amplifiers.
3. Wiring.
4. Masking speaker assemblies.
5. Controls.
6. Component mounting racks.

1.3 DEFINITIONS

A. Covered Spaces: Spaces above which masking speakers are installed.

1.4 SYSTEM DESCRIPTION

A. Zones: [Single] [Multiple]-zone coverage.

B. Channels: Single channel of masking sound to each zone.

C. Channels: Separate channel of masking sound to each of [two] [three] groups of speakers in each zone.

D. Signal Levels: Individually adjustable for each of 14 one-third octave bands centered at 200 through 4000 Hz, for sound-masking noise channels.

E. Sound-Power Level Produced by System: Match [NC 40] <Insert value> contour between [400 and 2000 Hz] <Insert value>, with smooth roll-off above and below those frequencies.
1. Initial Level: [40 dB] <Insert value>, A-weighted.
2. Final Adjusted Level: [40 to 50 dB] <Insert value>, A-weighted. Determine final level for each space individually by measurement as specified in Part 3.
3. Measurements: Made under calibration conditions.

F. Maximum Local Variance of Sound-Power Level: [6 dB] <Insert value> for the 500-Hz octave band and [3 dB] <Insert value> for the 1000-, 2000-, and 4000-Hz octave bands for 75 percent of the locations in covered spaces.

G. Maximum Average Range of Sound-Power-Level Deviation: [2 dB] <Insert value> in the 250-, 2000-, and 4000-Hz octave bands and [1.5 dB] <Insert value> for the 500- and 1000-Hz octave bands for all locations.

H. Directional Effect: People in covered spaces under calibration conditions cannot determine source of masking sound.

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I. Uniformity with Respect to Time: One-minute time-averaged sound-pressure level of any octave band of masking sound from [250 to 8000 Hz] <Insert value> remains constant in any space to within a standard deviation of [2 dB] <Insert value> when measured over a 30-minute period.

J. Sound Quality: No audible hum or noise from this system in covered spaces when noise generators are off and power amplifiers are on with input volume controls set at [50] <Insert number> percent.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include nationally recognized testing laboratory listing data.

B. Shop Drawings: Dimensioned plans and elevations showing minimum clearances and installed features and devices for system components. Show types and locations of masking speakers and their wiring connections, channel assignments, and axis orientations. Show ducts, beams, and other significant sound-reflecting and -absorbing elements in ceiling space and show locations of partitions below ceiling. Include a diagram showing interconnection of major system components for each zone and channel and indicating grounding connections.
1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified [Installer] [manufacturer] [and] [testing agency].

D. Product Certificates: For sound-masking equipment and components, signed by product manufacturer.

E. Field quality-control reports.

F. Operation and Maintenance Data: For sound-masking equipment and components to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer trained and approved by manufacturer of sound-masking equipment.

B. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing of sound-masking systems according to ASTM E 1130. Required experience includes having tested a minimum of five different systems within the last five years, each system similar in size and complexity to Project system.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

E. Comply with UL 813 unless a more stringent standard is specified in Part 2.

1.7 COORDINATION

A. Coordinate quantity and arrangement of speaker assemblies with ceiling space configuration and with components occupying ceiling space, including structural members, pipes, air-distribution components, raceways, cable trays, recessed lighting fixtures, and other items.

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1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sound-Masking Speaker Assemblies: [One] <Insert number> for each 10 of each type used, but no fewer than one.
   2. Fuses: [One] <Insert number> for each type used, but no fewer than one.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
   1. American Sound Masking, LLC.
   2. Atlas Sound LP.
   3. Dynasound, Inc.
   4. GE Security, Sound and Communications.
   5. Lencore.
   6. LynTec, Inc.
   7. Moeller, K. R. Associates Ltd.
   8. Proudfoot Company, Inc. (The).
   9. Sound Advance.
   10. <Insert manufacturer's name.>

2.2 GENERAL REQUIREMENTS FOR SOUND-MASKING EQUIPMENT

A. Components: Modular plug-in, heavy-duty, industrial-grade integrated circuit devices.

B. AC Supply Voltage Tolerance: 105 to 130 V with no degradation of system performance.

C. Protection from Power Line Surges: Integral surge protection devices listed in UL 1449; with the following features:
   1. Suppression Level: 300 V.
   2. Maximum Response Time: 5 nanoseconds.
   3. Circuit: Multistage, using inductors and silicon-avalanche zener diodes or equivalent.
   4. Indicator Lamp: Neon or light-emitting diode located on control panel and arranged to extinguish on failure of protection.
   5. Fuses: Externally accessible.

D. Component Housings: Suitable for mounting in standard 19-inch (480-mm) relay racks, with connections at rear and controls either on rear panel or protected by a screw-fastened security cover.

2.3 NOISE GENERATOR AND FILTER UNITS

A. Digital Masking Generator Spectra: Pink, white, and superwhite.

B. Pink Noise Generator: Output octave bands from 30 to 4000 Hz.

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C. Filters for One-Third Octave Bands: Adjustable from 10 dB of boost to 10 dB of cut at each center frequency.

D. Mixer Inputs: Two high level and one microphone level.

E. High-Pass Filter: Approximate range of cutoff adjustment is 37 to 400 Hz.

F. Low-Pass Filter: Adjustable roll-off frequency 100 Hz to 10 kHz.

G. High-Cut Filter: Approximate range of cutoff adjustment is 180 to 9000 Hz with slope varying to 12 dB per octave.

H. Auxiliary Inputs: Able to accept two, high-level, auxiliary signals such as music and telephone paging as well as general paging.

I. Mounting: Shelf or rack 3-1/2 inches (90 mm) high.

2.4 PROGRAMMABLE AUDIO-LEVEL CONTROL UNIT

A. Automatic Sound-Power-Level Changes: Six system channel changes, four times per day, and capable of different time settings for each day of week.

B. Level Changes: Programmable from front panel of unit, and automatically incremented over a period long enough for sound-level variations to be imperceptible to occupants of covered spaces.

C. Muting: Control unit shall be programmed to permit muting for emergency paging.

D. Built-in zone-level control shall drive other amplifiers and provide minimum [7] <Insert number>-position level control.

E. Program Memory: Nonvolatile for at least one year without power. When re-energized after a power outage, control starts at zero level and automatically advances system sound level at same rate used for programmed level changes.

2.5 POWER AMPLIFIERS

A. Power Amplifiers: Comply with CEA-426, and have the following minimum features:
1. Mounting: Rack mounted.
2. Output Regulation: Less than 2 dB from zero to full load.
3. Total Harmonic Distortion: Less than 3 percent, at rated power output from 50 to 12,000 Hz.
4. Signal-to-Noise Ratio: 60 dB or greater, at rated output.
5. Frequency Response: Within plus or minus 2 dB from 50 to 12,000 Hz.
6. Input: From internal masking or mixer board, or from an exterior source such as an automatic level control or other mixer.

2.6 MASKING SPEAKER ASSEMBLIES

A. Speakers: Cone type, with the following minimum features:
1. Minimum Axial Sensitivity: 45 dB.
2. Frequency Response: Within plus or minus 3 dB from 50 to 15,000 Hz.
3. Size: 8 inches (200 mm) with 1-inch (25-mm) voice coil and minimum 5-oz. (142-g) ceramic magnet unless otherwise indicated.
4. Dispersion Angle: 100 degrees.

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5. Rated Output Level: 10 W.

B. Configuration: Dual 8-inch (200-mm) and dual 5-inch (125-mm) units mounted on metal baffles and arranged for optimum, multidirectional, angular sound distribution. Arrange units for suspension from the building structure above the ceiling.

C. Matching Transformers: Full-power rated with 4 standard taps, and a maximum insertion loss of 0.5 dB.

D. Assemblies installed in air-handling spaces shall comply with NFPA 70 requirements for rate of heat-release and rate of smoke-release characteristics. Tests for these requirements shall be according to UL 2043.

2.7 WIRE

A. Speaker Wire: UTP cable complying with manufacturer's requirements; listed and labeled for environmental air plenums where cable is indicated in plenum spaces and is not indicated to be in raceway. Comply with requirements in Division 16 Section "Communications Horizontal Cabling."

2.8 COMPONENT MOUNTING RACKS

A. Configuration: Comply with CEA-310-E. Factory-fabricated units designed for interchangeable mounting, forced or convection air cooling, wiring connection, and enclosure of standard 19-inch (482-mm) relay rack modules.

B. Mounting Provisions: Equipped for freestanding floor mounting.

C. Cabinet: Factory-finished steel with component mounting rails and prewired plug strips for component power connections. Full front and rear doors with continuous hinges, handles, and cylindrical keyed locks.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Speaker Assemblies: Suspend with chains from building structure above ceilings so bottom of assembly is 6 to 8 inches (150 to 200 mm) above upper plane of finished ceiling material. Use eyebolts on speaker assemblies for attachment. Suspend independently of supports for components of other building systems.

B. Install seismic restraints on speakers. Comply with requirements for seismic-restraint devices specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

C. Speaker Connections: For two- or three-channel systems, connect speaker assemblies alternatively so masking sound is redundant throughout zones of coverage.

D. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and unless otherwise indicated.
1. Except raceways are not required in accessible indoor ceiling spaces and attics.
2. Except raceways are not required in hollow gypsum board partitions.
3. Conceal raceways and wiring except in unfinished spaces.

E. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

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1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements specified in Division 16 Section "Communications Horizontal Cabling" for cable trays
3. Comply with requirements for raceways and boxes specified in Division 16 Section "Raceways and Boxes."
4. Comply with requirements in Division 16 Section "Communication Horizontal Cabling."

F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

G. Exposed Cable: Install parallel to building lines, follow surface contours, and support as recommended by manufacturer.

H. Grounding: As recommended by manufacturers unless more stringent requirements are indicated. Ground equipment and conductors to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments with a maximum of 5-ohm to ground at main equipment location. Measure, record, and report ground resistance.

I. Impedance Matching: For system components, including connecting cable, provide end-to-end level and impedance-matched signal paths. Use matching networks and balancing devices at connections where necessary to avoid mismatches.

J. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

A. Use color-coded conductors and apply wire and cable marking tape to designate wires and cables so media are identified in coordination with system wiring diagrams. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."

B. Label speaker assemblies as to channel, zone, and address.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:
1. Operational Test: Start system to confirm proper operation. Remove malfunctioning units, replace with new units, and retest. Make initial sound-spectrum and -level adjustments for each zone.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

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3. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
4. Pretesting: Tune, align, and adjust system and pretest components, wiring, and functions to verify they comply with specified material, installation, and performance requirements. Correct deficiencies and retest until satisfactory performance and conditions are achieved.
5. Masking Sound-Power-Level Adjustments: Adjust independently for each space to minimum level between 40 and 50 dB that will provide speech privacy between adjacent workstations while complying with other system requirements.

E. Final Acceptance Testing: Provide a minimum of 10 days' notice of acceptance test performance schedule. Schedule tests after pretesting has been successfully completed.
1. Tests and Calibration Conditions: Spaces shall be completely furnished but unoccupied; lights and HVAC systems shall be on; HVAC system testing and balancing shall be completed; and electronic ballasts, lighting relay panels, and low voltage transformers shall be in place.
2. Test Conditions: Complying with ASTM E 1130 and calculated according to ANSI S3.5.
3. Instrumentation: Use a professional-quality, sound-level meter with octave-band filters and documentation of recent calibration against recognized standards.
4. Record test observations, readings, and corrective actions.
5. System Tests: Include the following for each system zone:
   a. Speaker Circuit Impedance Test: Measure impedance at 1000 Hz with amplifier disconnected, using a professional impedance meter or bridge. Locate and correct faults denoted by abnormal readings.
   b. Ambient Sound-Level Tests: With system off, measure ambient sound level in one-third octave bands. Also measure ambient sound level as a single, wide-band, A-weighted reading.
   c. Amplifier Noise Test: Check for performance specified in "System Description" Article with masking noise generator off and amplifiers on.
   d. System Noise Test: With masking noise signal on and amplifiers adjusted at a working level 10 dB above ambient sound level, check for hum, buzz, rattle, or other operating deficiencies.
   e. Spatial Uniformity Test: Measure sound level at locations no greater than 15 feet (4.6 m) o.c. throughout covered spaces to determine compliance with specified performance level.
   f. Frequency Response Adjustment and Test: Adjust one-third octave frequency bands and other unit filters to provide response. Adjust to meet requirement of space speech intelligibility and quality of background sound. Comply with ANSI S3.2, CEA 426, and ASTM E 1110.
6. Adjust level of masking sound for each space so one-third octave band centered at 500 Hz has final selected sound-power level for that space. Measure deviation from listed values in one-third octave bands from 100 to 1000 Hz. Measured values must not deviate from those listed by more than 4 dB for open plan areas and 8 dB for enclosed offices. The total of individual band deviations in eight bands must not exceed 16 dB for open plan areas and 30 dB for enclosed offices.
7. Walk-through Test: People in covered spaces cannot discern speaker locations.
8. Temporal Stability Test: Check for uniformity of time by measuring sound level in each of 14 octave bands at one-minute intervals over a 30-minute test period. Deviations must not exceed limits specified in "System Description" Article.
9. Where required, space shall meet the Health Insurance Portability and Accountability Act for privacy and the Gramm-Leach Bliley Act to protect consumer personal and financial information in open office layouts.

F. Retest: Correct deficiencies identified by tests and observations and retest until meeting specified requirements.

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G. Recording Control Settings and System Adjustments: Record final control settings and programming, and final tap setting of speaker matching transformers. Record final sound-level measurements and observations.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within [12] <Insert number> months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [two] <Insert number> visits to Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION

A. [Engage a factory-authorized service representative to train] [Train] Owner's maintenance personnel to adjust, operate, and maintain services.

END OF SECTION 16727

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SECTION 16785 - MASTER ANTENNA TELEVISION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. MATV equipment using [**cable television service**] [**direct broadcast satellite service**] [**an off-air antenna system**] [**CCTV cameras and video recorders**] as the signal source.
2. Off-air antennas.
3. MATV head-end components.
4. Distribution components.

B. Related Sections:
1. Division 13 Section "Video Surveillance" for cameras, monitors, computers, and cabling for video surveillance systems.
2. Division 16 Section "Communications Backbone Cabling" for coaxial, UTP, and fiber-optic cables and connectors.
3. Division 16 Section "Communications Horizontal Cabling" for coaxial, UTP, and fiber-optic cables and connectors.

1.3 DEFINITIONS

A. Agile Receiver: A broadband receiver that can be tuned to any desired channel.

B. A/V: Audio/Visual.

C. Broadband: For the purposes of this Section, wide bandwidth equipment or systems that can carry signals occupying in the frequency range of 54 to 1002 MHz. A broadband communication system can simultaneously accommodate television, voice, data, and many other services.

D. Carrier: A pure-frequency signal that is modulated to carry information. In the process of modulation, the signal is spread out over a wider band. The carrier frequency is the center frequency on any television channel.

E. CATV: Community antenna television. A communication system that simultaneously distributes several different channels of broadcast programs and other information to customers via a coaxial cable.

F. CCTV: Closed-circuit television.

G. CEA: Consumer Electronics Association.

H. dBmV: Decibels relative to 1 mV across 75 ohms. Zero dBmV is defined as 1 mV across 75 ohms. dBmV = 20 log $10(V_1/V_2)$ where V_1 is the measurement of voltage at a point having identical impedance to V_2 (0.001 V across 75 ohms).

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I. Headend: The control center of the MATV system, where incoming signals are amplified, converted, processed, and combined into a common cable along with any locally originated television signals, for transmission to user-interface points. It is also called the "central retransmission facility."

J. I/O: Input/Output.

K. MATV: Master antenna television. A small television antenna distribution system usually restricted to one or two buildings.

L. RF: Radio frequency.

M. User Interface: End point of Contractor's responsibility for Work of this Section. User interfaces are the [terminal blocks to which the end user may connect coaxial cabling] [75-ohm terminals on device plates] <Define user-interface points>.

1.4 SYSTEM DESCRIPTION

A. System shall consist of [cable television service] [direct broadcast satellite service] [an off-air antenna system] [CCTV cameras and video recorders] and a coaxial cable distribution system.
   1. Headend equipment shall consist of receiving antennas, satellites, and associated signal distribution amplification and equalization.
   2. Distribution of direct broadcast satellite-service signals, which includes coordinating with Owner's selected service provider for installation of its dish-type antennas and processing the signals as needed to provide specified services combined into a single-feed point ready for connection into the distribution system. Obtain signal levels and noise and distortion characteristics from service provider as the point of departure for system layout and final equipment selection.
   3. Distribution of cable television service signals, which includes coordinating with Owner's selected service provider for installation of cable to the service point ready for connection into the distribution system. Obtain signal levels and noise and distortion characteristics from service provider as the point of departure for system layout and final equipment selection.
   4. Cable distribution system consisting of coaxial cables, user interfaces, signal taps and splitters, RF amplifiers, signal equalizers, power supplies, and required hardware, complying with CEA-310-E and CEA-2032 and resulting in performance parameters specified in this Section. System shall be capable of distributing television channels according to CEA-542-B.

B. Hardware Requirements: Use plug-in, modular, solid-state electronic components. Mount amplifiers and other powered equipment in standard 19-inch (483-mm) cabinet complying with CEA-310-E.

C. Off-Air Stations: Install antennas for the reception and distribution of selected stations.

1.5 PERFORMANCE REQUIREMENTS

A. Minimum acceptable performance of distribution system at all user-interface points shall be as follows:
   1. RF Video-Carrier Level: Between 3 and 12 dBmV.
   2. Relative Video-Carrier Level: Within 3 dB to adjacent channel.
   3. Carrier Level Stability, Short Term: Level shall not change more than 0.5 dB during a 60-minute period.
   4. Carrier Level Stability, Long Term: Level shall not change more than 2 dB during a 24-hour period.

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5. Channel Frequency Response: Across any 6-MHz channel in the 54- to 220-MHz frequency range, referenced to video; signal amplitude shall be plus or minus 1 dB, maximum.
6. Carrier-to-Noise Ratio: 45 dB or more.
7. RF Visual Signal-to-Noise Ratio: 43 dB or more.
8. Antenna Combiner Insertion Loss: 40 dB maximum.
9. Signal Power Splitter and Isolation Tap Return Loss: 17 dB maximum.
10. Cable Connectors Attenuation: Less than 0.1 dB.
11. Cross Modulation: Less than minus 50 dB.
12. Carrier-to-Echo Ratio: More than 40 dB.
13. Composite Triple Beat: Less than minus 53 dB.
14. Second Order Beat: Less than minus 60 dB.
15. Terminal Isolation from Television to Television: 25 dB, minimum.
16. Terminal Isolation between Television and FM: 35 dB, minimum.
17. Hum Modulation: 2 percent, maximum.
18. RF FM Carrier Level: 13 to 17 dB below video-carrier level.
19. FM Frequency Response: More than in the 88- to 108-MHz frequency range; signal amplitude is plus or minus 0.75 dB, maximum.
20. FM Carrier-to-Noise Ratio: More than 24 dB.

1.6 SUBMITTALS

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

B. Shop Drawings: For headend and distribution system. Include plans, elevations, sections, details, and attachments to other work.
1. Show fabrication and installation details for television equipment.
2. Functional Block Diagram: Show single-line interconnections between components for headend and distribution system to user-interface points. Show cable types and sizes.
3. Dimensioned Plan and Elevations of Headend Equipment: Show access and workspace requirements.
4. Wiring Diagrams: For power, signal, and control wiring. For UTP or fiber-optic cable, include cross connects, patch panels, and patch cords.

C. Samples: Full size for each outlet device plate in required colors and textures.

D. Design Calculations: Calculate signal attenuation budget and show calculated line and equipment losses for the system based on the functional block diagram, to show that proposed system layout can be expected to perform up to specification. Calculate signal strength from sources to headend input points for each antenna, satellite dish, and CATV grouping. Allowable losses between components and user interface shall be used to determine size and type of coaxial cable.

E. Coordination Drawings: Include dimensioned plan and elevation views of components and enclosures. Show access and workspace requirements.

F. Equipment List: Include each piece of equipment and include model number, manufacturer, serial number, location, and date of original installation. Insert testing record of each piece of adjustable equipment, listing name of person testing, date of test, and description of as-left set points.

G. Field quality-control reports.

H. Operation and Maintenance Data: For headend and distribution system to include in emergency, operation, and maintenance manuals.

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1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: System components shall be equipped and rated for the environments in which they are installed.

B. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. Interior, Controlled Environment: System components, except central-station control unit, installed in [**air-conditioned**] [**temperature-controlled**] interior environments shall be rated for continuous operation in ambient conditions of [**36 to 122 deg F (2 to 50 deg C)**] <**Insert temperature range**> dry bulb and 20 to 90 percent relative humidity, noncondensing.
2. Interior, Uncontrolled Environment: System components installed in non-[**air-conditioned**] [**temperature-controlled**] interior environments shall be rated for continuous operation in ambient conditions of [**0 to 122 deg F (minus 18 to plus 50 deg C)**] <**Insert temperature range**> dry bulb and 20 to 90 percent relative humidity, noncondensing.
3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of [**minus 30 to plus 122 deg F (minus 34 to plus 50 deg C)**] <**Insert temperature range**> dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to [**85 mph (137 km/h)**] <**Insert wind speed**> [**and snow cover up to 24 inches (610 mm) thick**].

1.9 COORDINATION

A. Coordinate size and location of raceway system and provisions for electrical power to equipment specified in this Section.

B. Coordinate Work of this Section with requirements of [cable television service] [direct broadcast satellite service] [an off-air antenna system] [CCTV cameras and video recorders] service provider.

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

D. Coordinate installation of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide [**three**] [**six**] [**nine**] [**12**] months' full maintenance by skilled employees of MATV system Installer. Include quarterly adjusting as required for optimum system performance. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

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1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Provide no fewer than one of each item listed below. Deliver extra materials to Owner.
   1. Fuses: One for every [**10**] <**Insert number**> of each type and rating.
   2. Splitters: One for every [**10**] <**Insert number**> installed.
   3. MATV Distribution Power Amplifiers: One for every [**10**] <**Insert number**>of each type installed.
   4. MATV Signal Traps: [**One**] <**Insert number**> for every [**10**] <**Insert number**> of each type used.
   5. MATV Attenuators: [**One**] <**Insert number**> for every [**10**] <**Insert number**> of each type used.
   6. Cable: 100 feet (30 m) of each type used.

PART 2 - PRODUCTS

2.1 SYSTEMS REQUIREMENTS

A. Components: Plug-in, modular, heavy-duty, industrial- or commercial-grade units.

B. Equipment: Silicon-based, solid-state, integrated circuit devices.

C. Power Supply Characteristics: Devices shall be within specified parameters for ac supply voltages within the range of 105 to 130 V.

D. Protect signal cables and connected components against transient-voltage surges by suppressors and absorbers designed specifically for that purpose. Comply with requirements in Division 16 Section "Transient Voltage Suppression."

E. Provide ac-powered equipment with integral surge suppressors complying with UL 1449.

F. RF and Video Impedance Matching: Signal-handling components, including connecting cable, shall have end-to-end impedance-matched signal paths. Match and balance devices used at connections where it is impossible to avoid impedance mismatch or mismatch of balanced circuits to unbalanced circuits.

2.2 MATV EQUIPMENT

A. Description: Signal-source components, signal-processing and amplifying equipment, distribution components, and interconnecting wiring. System shall receive, amplify, process, and distribute signals to outlets for receiving sets. Equipment shall translate UHF channels to VHF channels before distribution to outlets.

B. Identification of Signal Sources Distributed:
   1. <**Insert signal sources and basic service selection**>.

C. MATV System Qualitative and Quantitative Performance Requirements: Reception quality of color-television program transmissions at each system outlet from each service and source shall be equal to or superior than that obtained with performance checks specified in "Field Quality Control" Article, using standard, commercial, cable-ready, multiple A/V input color-television receivers.

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2.3 OFF-AIR ANTENNAS

A. Antennas shall be tested, marked, and packaged, according to CEA-774-A, CEA-2028, and CEA-2032. Antennas shall be labeled according to CEA antenna mapping program.

B. Off-Air, Mast-Mounted Antennas: Weatherproof single-channel or broadband type, constructed of high-strength anodized aluminum and rated to survive in a [**100-mph (160-km/h)**] <**Insert speed**> wind, minimum.
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Channel Master; Part of Andrew Corporation.
   b. RadioShack Corporation.
   c. TERK by Audiovox; a subsidiary of Audiovox Corporation.
   d. Winegard Company.
   e. <**Insert manufacturer's name**>.
3. Elements: Internally dampened against mechanical vibration that may occur in service.
4. Ends of Crossarms and Elements: Sealed.
5. Mounting and Connecting Hardware: Corrosion proof.
6. Frequency Range: Matched to source frequencies.
7. CEA Reception Patterns: <**Insert reception pattern and number of antennas**>.
8. FM Antenna: Separate from the broadband antenna and the [**omnidirectional**] [**directional**] antenna, with 2-dB minimum gain.

C. Antenna-Supporting Structures: Prefabricated, hot-dip galvanized-steel units.
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Channel Master; Part of Andrew Corporation.
   b. RadioShack Corporation.
   c. TERK by Audiovox; a subsidiary of Audiovox Corporation.
   d. Winegard Company.
   e. <**Insert manufacturer's name**>.
3. Strength of Structure and Attachments: Adequate to withstand [**100-mph (160-km/h)**] <**Insert speed**> winds while supporting installed antennas.
4. Comply with 47 CFR 17 and TIA 222-G.
5. Comply with FAA AC 70/7460-1K.

2.4 MATV HEADEND COMPONENTS

A. Headend Equipment: [**Channel mixers**] [**Processors**] [**Broadband amplifier**] [**Single-channel amplifiers**] [**FM module**] [**Combining networks**] for receiving off-air television and FM signals and outputting the signals to cable distribution system. Equip coaxial down-leads of the off-air antennas with preamplifiers to send signals at strength required by headend. Headend component performance specified in this article is minimum acceptable; better performance may be required to comply with minimum acceptable system performance standard in "Performance Requirements" Article.
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

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2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Blonder Tongue Laboratories, Inc.
   b. Canare Corp.
   c. Channel Master; Part of Andrew Corporation.
   d. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.
   e. Motorola, Inc.; Connected Home Solutions.
   f. Quality RF Services, Inc.; a member company of ATX Networks.
   g. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
   h. <**Insert manufacturer's name**>.
3. House units in standard 19-inch (483-mm) electronic equipment cabinet complying with EIA 310.

B. Antenna Combiner: Directional coupler design network, combining up to eight antenna signals into a single output. Frequency response of the device shall be 5 to 400 MHz, and the insertion loss between input ports shall be not less than 40 dB.
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Blonder Tongue Laboratories, Inc.
   b. Canare Corp.
   c. Channel Master; Part of Andrew Corporation.
   d. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.
   e. Motorola, Inc.; Connected Home Solutions.
   f. Quality RF Services, Inc.; a member company of ATX Networks.
   g. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
   h. <**Insert manufacturer's name**>.

C. Down-Lead Preamplifiers: Antenna mast-mounted preamplifier, designed to boost antenna signal and contained in weatherproof housing; single-channel or broadband type. Install power supplies indoors at headend equipment, connected through power inserters to provide power to preamplifiers through the coaxial down-lead cable.
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Blonder Tongue Laboratories, Inc.
   b. Canare Corp.
   c. Channel Master; Part of Andrew Corporation.
   d. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.
   e. Motorola, Inc.; Connected Home Solutions.
   f. Quality RF Services, Inc.; a member company of ATX Networks.
   g. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
   h. <**Insert manufacturer's name**>.
3. Frequency Response: Plus or minus 0.75 dB.
4. Minimum Input: Minus 20 dBmV.
5. Return Loss: 14 dB.
6. I/O Impedance: 75 ohms.

D. Channel Mixers: Use for nonadjacent channels only.

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1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Blonder Tongue Laboratories, Inc.
   b. Canare Corp.
   c. Channel Master; Part of Andrew Corporation.
   d. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.
   e. Motorola, Inc.; Connected Home Solutions.
   f. Quality RF Services, Inc.; a member company of ATX Networks.
   g. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
   h. <**Insert manufacturer's name**>.
3. Insertion Loss (Maximum 54 to 216 MHz): 2.5 dB.
4. Return Loss: 14 dB.
5. Out-of-Band Rejection: 12 dB.
6. I/O Impedance: 75 ohms.

E. Processors: One for each channel to be translated.
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Blonder Tongue Laboratories, Inc.
   b. Canare Corp.
   c. Channel Master; Part of Andrew Corporation.
   d. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.
   e. Motorola, Inc.; Connected Home Solutions.
   f. Quality RF Services, Inc.; a member company of ATX Networks.
   g. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
   h. <**Insert manufacturer's name**>.
3. Bandwidth: 6 MHz.
4. Return Loss: 16 dB, within the 6-MHz bandwidth.
5. Noise: Not more than 10 dB at maximum gain.
6. Input Level Range, VHF: Minus 20 to plus 30 dBmV.
7. Input Level Range, UHF: Minus 20 to plus 25 dBmV.
8. Output Level Range: 50 to 60 dBmV.
9. Carrier-to-Noise Ratio: Minus 57 dB at plus 10-dBmV input.
10. Automatic Gain Control: Plus or minus 1-dB output variation for rated input level range variation.
11. Frequency Stability: Plus or minus 10 kHz over the operational temperature range.
12. Spurious Output: 60 dB below the video carrier with video-carrier output level at plus 60 dBmV and audio-carrier level at plus 45 dBmV.
13. Adjacent Channel Rejection: Not less than 60 dB.
14. I/O Impedance: 75 ohms.

F. Broadband Amplifier:
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:

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a. Blonder Tongue Laboratories, Inc.
b. Canare Corp.
c. Channel Master; Part of Andrew Corporation.
d. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.
e. Motorola, Inc.; Connected Home Solutions.
f. Quality RF Services, Inc.; a member company of ATX Networks.
g. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
h. <**Insert manufacturer's name**>.

3. Frequency Range: [**54 to 108, 174 to 220**] [**54 to 220**] MHz.
4. Frequency Response: Plus or minus 1.0 dB across passband.
5. Maximum Noise: 10 dB.
6. Minimum Return Loss: 16 dB.
7. I/O Impedance: 75 ohms.

G. Single-Channel Amplifiers:
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Blonder Tongue Laboratories, Inc.
   b. Canare Corp.
   c. Channel Master; Part of Andrew Corporation.
   d. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.
   e. Motorola, Inc.; Connected Home Solutions.
   f. Quality RF Services, Inc.; a member company of ATX Networks.
   g. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
   h. <**Insert manufacturer's name**>.
3. Frequency: 6 MHz for specified channel.
4. Frequency Response: Plus or minus 0.5 dB.
5. Maximum Noise: 10 dB.
6. Minimum Return Loss: 14 dB.
7. Automatic Gain Control: Plus or minus 1-dB output variation for rated input level range variation.
8. Skirt Rejection: Minus 26 dB at plus or minus 5 MHz from channel center.
9. Sound Trap: Adjustable to 10 VdB of attenuation of the sound carrier.
10. I/O Impedance: 75 ohms.

H. FM Module: One RF processor module for each station listed.
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Blonder Tongue Laboratories, Inc.
   b. Canare Corp.
   c. Channel Master; Part of Andrew Corporation.
   d. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.
   e. Motorola, Inc.; Connected Home Solutions.
   f. Quality RF Services, Inc.; a member company of ATX Networks.
   g. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
   h. <**Insert manufacturer's name**>.
3. Frequency Range: Between 88 and 108 MHz.
4. Output Level: 52 dBmV.

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5. Output Level Control: Plus or minus 10 dB.
6. Stability: 0.005 percent, crystal controlled.
7. Sensitivity: 3 mV for 30-dB quieting.
8. Input Level: 60 mV, stereo.
9. Image Rejection: 901 dB.
10. Passband: 200 kHz.
11. Selectivity: Plus or minus 150 kHz or less, at 30 dB down. Plus or minus 250 kHz or less, at 50 dB down.

I. Combining Network (Mixer): Combines the off-air television [**FM**] [**CCTV**] [**and**] [**CATV**] signals into a single-broadband output. An output test point, a 75-ohm television jack, a mixer output step attenuator dual-pilot insertion network, and a removable mixer-to-trunk jumper are included.
1. Passband: As required by system performance.
2. Distortion: Not more than plus or minus 0.1 dB over any 6-MHz segment.
3. Distortion: Not more than plus or minus 0.5 dB over the 54- to 216-MHz frequency range.
4. Nominal Insertion Loss:
   a. 15 dB maximum, channel input to single-system output.
   b. 13 dB maximum, channel input to mixer output.
   c. 20 dB maximum at test point, e.g., loss from trunk output.
5. Isolation between any Two Inputs: 30 dB.
6. I/O Impedance: 70 ohms.

2.5 DISTRIBUTION COMPONENTS

A. Signal Power Splitters and Isolation Taps: Metal-enclosed directional couplers with brass connector parts. Where installed in signal circuits used to supply cable-powered amplifiers, power throughput capacity shall exceed load by at least 25 percent.
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Canare Corp.
   b. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.
   c. Motorola, Inc.; Connected Home Solutions.
   d. Quality RF Services, Inc.; a member company of ATX Networks.
   e. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
   f. <**Insert manufacturer's name**>.
3. Return Loss: 17 dB.
4. RFI Shielding: 100 dB.
5. Isolation: 25 dB.
6. I/O Impedance: 75 ohms.

B. Distribution System Amplifiers: Powered by coaxial cable system and equipped with surge protection device and external test points to allow convenient signal monitoring.
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Canare Corp.
   b. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.

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c. Motorola, Inc.; Connected Home Solutions.
d. Quality RF Services, Inc.; a member company of ATX Networks.
e. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
f. <**Insert manufacturer's name**>.

C. Cable System Power Supplies: Plug-in, modular construction, with surge, short-circuit, and overload protection.

D. Signal Traps: Packaged filters tuned to interference frequencies encountered in Project.

E. Attenuators: Passive, of fixed value, and used to balance signal levels.

F. Terminating Resistors: Enclosed units rated 0.5 W and matched for coaxial impedance.

G. User-Interface Device: Flush, female-type outlets, designed to mimic power duplex outlet; for mounting in standard outlet box; with metallic parts of anodized brass, beryllium copper, or phosphor bronze. Cable connector mounting shall be semirecessed so its protrusion is flush with the plane of device plate.[**Feed-through-type cable connection shall not be used**] [**except in area housing a single tenant**] [**except within a single-dwelling unit**].
1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a. Canare Corp.
   b. Leviton Manufacturing Co., Inc.; Leviton Voice & Data Division.
   c. Motorola, Inc.; Connected Home Solutions.
   d. Quality RF Services, Inc.; a member company of ATX Networks.
   e. Scientific-Atlanta, Inc.; a subsidiary of Cisco Systems, Inc.
   f. <**Insert manufacturer's name**>.
3. Cable Connector: Female, Type F.
4. Wall Plates: Match materials and finish of power outlets in same space.
5. Attenuation: Less than 0.1 dB.
6. Voltage Standing-Wave Ratio: Less than 1.15 to 1.

2.6 ENCLOSURES

A. Enclosures for Interior, Controlled Environments: NEMA 250, Type 1.

B. Enclosures for Interior, Uncontrolled Environments: NEMA 250, [**Type 3R**] [**Type 4**] [**Type 12**] [**Type 12K**].

C. Enclosures for Exterior Environments: NEMA 250, [**Type 3**] [**Type 3R**] [**Type 3S**] [**Type 4**] [**Type 4X**].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for antenna to verify actual locations of cable connections before antenna installation.

B. Examine walls, floors, roofs, equipment bases, and roof supports for suitable conditions where television equipment is to be installed.

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

3.2 INSTALLATION

A. Install signal line surge suppressors on coaxial cables entering headend equipment space and at antenna-mounted amplifiers. Comply with requirements in Division 16 Section "Transient Voltage Suppression."

B. Install antenna towers, masts, and mountings on concrete bases. Comply with requirements for concrete bases specified in Division 3 Section "[**Cast-in-Place Concrete**] [**Cast-in-Place Concrete (Limited Applications)**]."
   1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.3 ANTENNA AND HEADEND INSTALLATION

A. Mount headend equipment in electronic-equipment cabinets recommended by manufacturer. Group related items in methodical sequence.

B. Arrange equipment to facilitate access for maintenance and to preserve headroom and passage space. Parts that require periodic service or maintenance shall be readily accessible. Headend components that require tuning adjustments shall be accessible from the front of equipment cabinets.

C. Align antenna elements to achieve maximum signal level and quality.

D. Antenna-Supporting Structure: Increase antenna height as required to obtain signal strength needed for specified system performance.
   1. Attachment to Building: Use 0.375-inch- (10-mm-) minimum expansion anchors for masonry, and place anchors clear of grout or mortar joints.
   2. Attachment to Building: Use 0.375-inch- (10-mm-) minimum lag bolts for attachment to wood.
   3. Lightning Protection: Comply with requirements in Division 13 Section "Lightning Protection."

E. Antenna Cable Entrance: Use weatherproof entrance fittings, and seal at penetrations of the building envelope.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. 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.

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C. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

D. Tests and Inspections:
1. Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements.
2. Replace malfunctioning or damaged items.
3. Retest until satisfactory performance and conditions are achieved.
4. Prepare television equipment for acceptance and operational testing.
5. Use an agile receiver and signal strength meter or spectrum analyzer for testing.
6. Off-Air, Mast-Mounted Antenna Sources: Connect receiver to the down-lead of a 10-element, single-channel antenna, tuned and oriented to optimize reception for the channel and placed at system antenna's location. Alternatively, connect receiver to a single-channel video amplifier connected to the down-lead of the above single-channel antenna.
7. CATV Sources: Connect receiver to an agile demodulator or CATV set-top converter at CATV service entrance to the facility.
8. Satellite Earth-Station System Sources: Adapt receiver to the output of satellite-television receiver.
9. CCTV Sources: Connect receiver to the output of each CCTV signal source or the distribution amplifier associated with it.
10. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
11. Operational Tests: Perform tests of operational system to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
12. Distribution System Acceptance Tests:
    a. Field-Strength Instrument: Rated for minus 40-dBmV measuring sensitivity and a frequency range of 54 to 812 MHz, minimum. Provide documentation of recent calibration against recognized standards.
    b. Signal Level and Picture Quality: Use a field-strength meter or spectrum analyzer, and a standard television receiver to measure signal levels and check picture quality at [**all**] [**25 percent of**] <**Insert number or percentage**> user-interface outlets.
        1) Test the signal strength in dBmV at 55[**, 151, 547,**] and 750 MHz.
        2) Minimum acceptable signal level is 0 dBmV (1000 mV).
        3) Maximum acceptable signal level over the entire bandwidth is 15 dBmV.
        4) Television receiver shall show no evidence of cross-channel intermodulation, ghost images, or beat interference.
13. Signal-to-Noise-Ratio Test: Use a field-strength meter to make a sequence of measurements at the output of the last distribution amplifier or of another agreed-on location in system. With system operating at normal levels, tune meter to the picture carrier frequency of each of the designated channels in turn and record the level. With signal removed and input to corresponding headend amplifier terminated at 75 ohms, measure the level of noise at same tuning settings. With meter correction factor added to last readings, differences from first set must not be less than 45 dB.
14. Qualitative and Quantitative Performance Tests: Demonstrate reception quality of color-television program transmissions at each user interface from each designated channel and source. Quality shall be equal to or superior than that obtained with performance checks specified below, using a standard, commercial, cable-ready, color-television receiver. Level and quality of signal at each outlet and from each service and source shall comply with the following Specifications when tested according to 47 CFR 76:
    a. RF video-carrier level.
    b. Relative video-carrier level.
    c. Carrier level stability, during 60-minute and 24-hour periods.

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d. Broadband frequency response.
e. Channel frequency response.
f. Carrier-to-noise ratio.
g. RF visual signal-to-noise ratio.
h. Antenna combiner insertion loss.
i. Signal power splitter loss.
j. Cable connector attenuation.
k. Cross modulation.
l. Carrier-to-echo ratio.
m. Composite triple beat.
n. Second order beat.
o. Terminal isolation.
p. Terminal isolation between television and FM.
q. Hum modulation.
r. RF FM carrier level.
s. FM frequency response.
t. FM carrier-to-noise ratio.

E. Headend and distribution system will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

G. For fiber-optic- and UTP-cable performance test, see Division 16 Section "Communications Horizontal Cabling."

H. Cap all unused connectors and seal weathertight.

3.6 DEMONSTRATION

A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to adjust, operate, and maintain MATV equipment.
1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
2. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.
3. Demonstrate programming and tuning of satellite receivers.

END OF SECTION 16785

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SECTION 163111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Magnetic door holders.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only. New fire alarm system must be fully compatible with existing fire alarm system in building. Provide all required modules and upgrades to main panel for remodeled areas to meet current codes.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

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1.6 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified fire-alarm technician, Level IV minimum.
c. Licensed or certified by authorities having jurisdiction.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

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a. Frequency of testing of installed components.
b. Frequency of inspection of installed components.
c. Requirements and recommendations related to results of maintenance.
d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

F. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.8 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within one year from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. SimplexGrinnell LP; a Tyco International company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Duct smoke detectors.
6. Verified automatic alarm operation of smoke detectors.
7. Automatic sprinkler system water flow.
8. Heat detectors in elevator shaft and pit.
9. Fire-extinguishing system operation.
10. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Activate stairwell and elevator-shaft pressurization systems.
9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
10. Recall elevators to primary or alternate recall floors.
11. Activate emergency shutoffs for gas and fuel supplies.
12. Record events in the system memory.
13. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.

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5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

   a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable initiation devices that communicate device identity and status.

   a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
   b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.

   a. Initiating Device Circuits: [**Style D**] [**Style E**].
   b. Notification Appliance Circuits: Style Z.
   c. Signaling Line Circuits: Style 6.

2. Serial Interfaces: Two RS-232 ports for printers.

D. Smoke-Alarm Verification:

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1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

E. Notification Appliance Circuit: Operation shall sound in a temporal pattern.

F. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall.

   a. Elevator lobby detectors except the lobby detector on the designated floor.
   b. Smoke detector in elevator machine room.
   c. Smoke detectors in elevator hoistway.

2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.

   a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

J. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located in the fire command center.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.

   a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
   b. Programmable tone and message sequence selection.
   c. Standard digitally recorded messages for "Evacuation" and "All Clear."
   d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.

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2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed, valve-regulated, recombinant lead acid.

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

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a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

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2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

   a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished with color as selected by the Architect,.

D. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting: semirecessed or surface mounted and bidirectional.

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5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.8 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc.
4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to and external system or device for action as specified.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

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1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

D. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.

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6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

F. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

K. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

L. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

3.2 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems." Conceal raceway except in unfinished spaces and as indicated.

B. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

C. Cable Taps: Use numbered terminal strips in junction, pull and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

D. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

E. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signal from other floors or zones.

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F. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
2. Smoke dampers in air ducts of designated air-conditioning duct systems.
3. Alarm-initiating connection to elevator recall system and components.
4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
7. Supervisory connections at elevator shunt trip breaker.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.6 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Architect/Engineer and authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

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D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

~~G.~~ Obtain copy of fire marshal’s report and include in O&M Manual.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 163111

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